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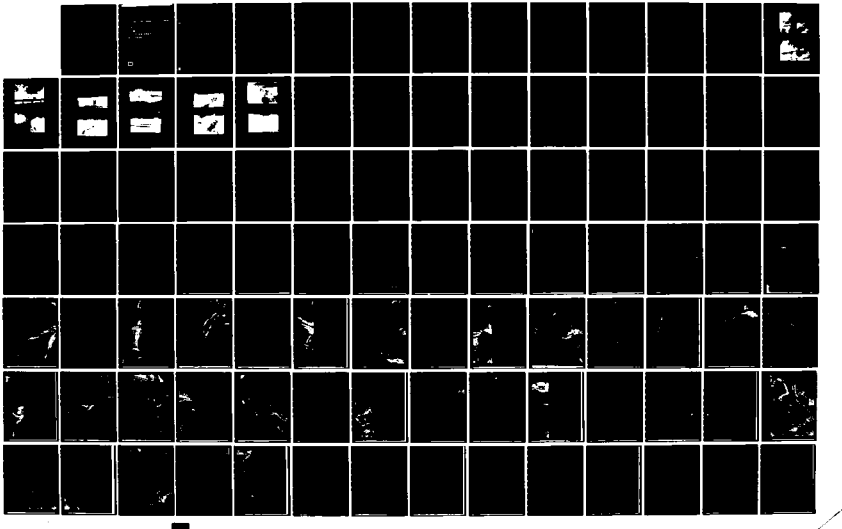

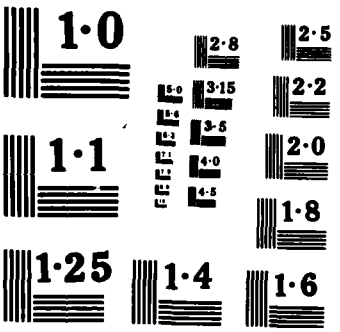
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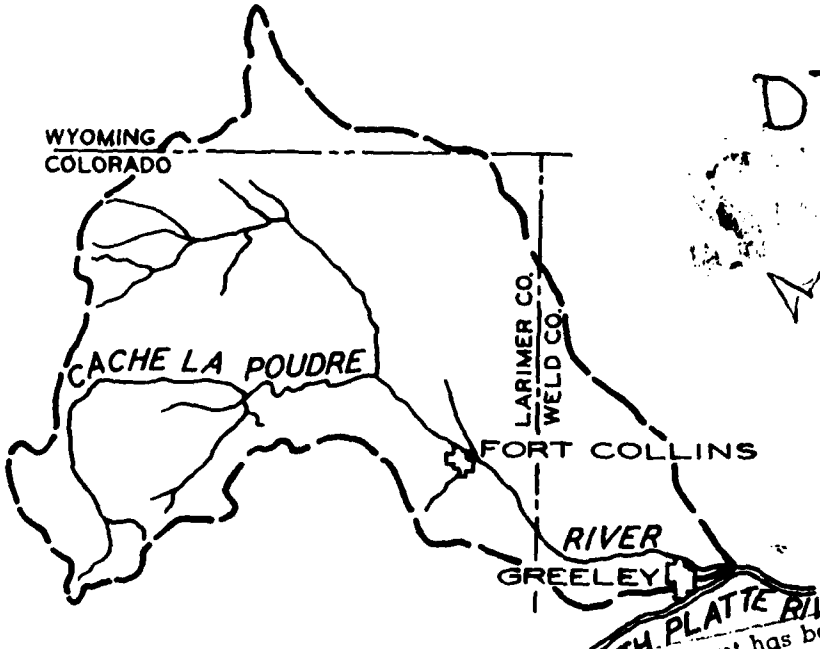
SPECIAL STUDY

OCTOBER 1981

CACHE LA POUDRE RIVER BASIN
LARIMER - WELD COUNTIES, COLORADO

VOLUME III
FLOOD PLAIN ANALYSIS
SHEEP DRAW



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The Cache la Poudre River basin in Colorado is in a rapidly growing area. The population of Larimer and Weld Counties increased by about 60 percent between 1970 and 1980. The basin contains a number of flood hazard areas, from narrow canyon flood plains in the mountainous west to wide valley flood plains in the east. Local interests are concerned about the changine nature of the flood hazards in the basin as a consequence of urban growth, particularly since the catastrophis B o Thompson River flood in the summer of 1976.

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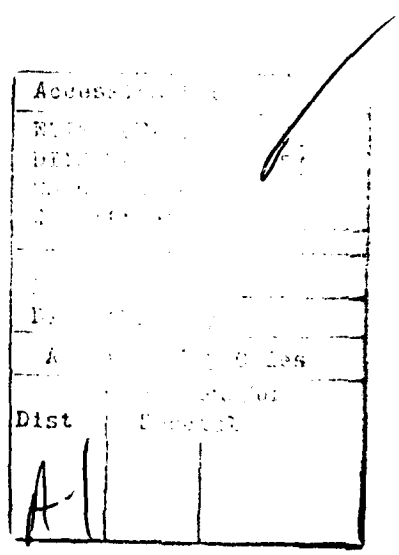
SPECIAL STUDY
CACHE LA POUDRE RIVER BASIN
LARIMER-WELD COUNTIES
COLORADO

VOLUME I	FLOOD HAZARD, DAM SAFETY, AND FLOOD WARNING
VOLUME II	HYDROLOGY
VOLUME III	FLOOD PLAIN ANALYSIS, SHEEP DRAW
VOLUME IV	FLOOD PLAIN ANALYSIS, FOSSIL CREEK



SPECIAL STUDY
CACHE LA POUDRE RIVER BASIN
LARIMER-WELD COUNTIES
COLORADO

VOLUME III
FLOOD PLAIN ANALYSIS
SHEEP DRAW

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SPECIAL STUDY
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FLOOD PLAIN ANALYSIS
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Introduction

BACKGROUND

The Cache la Poudre River basin in Colorado is in a rapidly growing area. The population of Larimer and Weld Counties increased by about 60 percent between 1970 and 1980. The basin contains a number of flood hazard areas, from narrow canyon flood plains in the mountainous west to wide valley flood plains in the east. Local interests are concerned about the changing nature of the flood hazards in the basin as a consequence of urban growth, particularly since the catastrophic Big Thompson River flood in the summer of 1976. Discussions regarding a wide ranging study of the basin were initiated between the Omaha District, Corps of Engineers and local planners and elected officials in 1977 and a plan of study was agreed upon.

AUTHORITY

This study was made under continuing authority in Section 206 of the 1960 Flood Control Act, as amended.

PURPOSE

The purpose of this study was to analyze flood-related problems and provide information that will enable local governments to make decisions that will minimize or reduce flood hazards in the future.

SCOPE OF THE SPECIAL STUDY

The course of the study was primarily determined through coordination with the Omaha District, Colorado Water Conservation Board, Larimer County, Weld County, the city of Fort Collins, the city of Greeley, and the Larimer-Weld Regional Council of Governments. Numerous other agencies and private interests were also contacted during the study.

As the study progressed, tasks were deleted or added in consultation with local interests to respond to changes in identified needs or priorities. Since some work items were independent of other study tasks, the study results are presented in four separate volumes. Volume I considers basin flood hazards, dam safety, and flood warning. Volume II presents the detailed hydrologic analysis for the basin. Volumes III and IV present flood plain studies for Sheep Draw and Fossil Creek, respectively, which are two tributaries of the Cache la Poudre River lying in the path of current urbanization. All geographic locations referred to are in the State of Colorado unless otherwise indicated.

PURPOSE AND SCOPE OF VOLUME III

One purpose of the Cache la Poudre River Basin Special Study is to present data on existing and future flood potential for streams subject to the effects of increasing urbanization. Two streams in the Cache la

Poudre River basin which meet this criteria are Fossil Creek near Fort Collins and Sheep Draw near Greeley. Local interests also assigned these streams priority for study. Volume III of the Special Study covers Sheep Draw and Volume IV covers Fossil Creek. The locations of these basins are shown on plate 1.

Hydrologic modeling studies were conducted to determine the peak discharges for floods of various probabilities of occurrence. This information was developed first for existing watershed land use. To determine the effect of increasing urbanization on flood runoff, possible future urban land use was superimposed on the Sheep Draw basin. Volume II of this study presents details of the hydrologic studies. Hydraulic modeling studies were conducted to develop the flood water surface profiles and flood plain boundaries. Flood profiles are shown for existing and future conditions. Flooded area maps are shown for existing conditions.

ACKNOWLEDGEMENTS

Principal cooperation and coordination for Volume III was with representatives of the Federal Emergency Management Agency (FEMA), the Colorado Water Conservation Board (CWCB), Weld County, and the city of Greeley.

RELATED STUDIES

Sheep Draw was included in the report Flood Insurance Study, Weld County, Colorado, Unincorporated Areas and Town of Eaton, Colorado, Weld County, published by FEMA in December 1979. This study included Flood Boundary and Floodway Maps (FBFM) and Flood Insurance Rate Maps (FIRM), with an effective date of 18 March 1980.

The present study was based on new topographic mapping and cross sections taken at closer intervals than in the Flood Insurance Study (FIS). Also, the study reach on Sheep Draw was extended farther upstream than in the FIS which ended at U.S. Highway 34. In this study, the Environmental Protection Agency's (EPA) Stormwater Management Model (SWMM) was used to determine flood discharges. Peak discharges for floods of various frequency were computed using the U.S. Soil Conservation Service (SCS) Technical Release No. 20 computer program in the FIS. The 100-year flood discharge for the present study averages about 90 percent of the discharge used in the FIS. Downstream from County Road 29 (71st Avenue), the 100-year floodwater surface profile for the present study generally ranges from 1 to 5 feet higher than in the FIS with the depth variations increasing in the downstream direction. Upstream from County Road 29, the 100-year flood profile in the present study generally varies less than a foot above or below the 100-year profile in the FIS.

LOCATION OF DATA

Copies of this report are available for public distribution at the offices listed below. Topographic, hydrologic, and hydraulic data used in this study are also on file in the Flood Plain Management Services Branch, Omaha District Corps of Engineers, 215 North 17th Street, Omaha, NE 68102.

Department of Planning Services
Weld County Centennial Center
915 10th Street
Greeley, CO 80631

County Engineer
Weld County
P.O. Box 758
Greeley, CO 80631

Colorado Water Conservation Board
823 State Centennial Building
1313 Sherman Street
Denver, CO 80203

Flood Plain Analysis

STUDY AREA DESCRIPTION

Sheep Draw, a right-bank tributary of the Cache la Poudre River, is located west of Greeley in Weld County. It begins about 8 miles west of Greeley and flows northeastwa i to its confluence with the Cache la Poudre River just northwest o Greeley. The basin is about 2 miles in width and about 8 miles long. The Sheep Draw drainage area is about 15.0 square miles. A map of the basin is shown on plate 2.

The basin topography is characterized by rolling hills and narrow stream valleys. Elevations in the basin range from about 5050 feet to 4690 feet above mean sea level. Sheep Draw slopes about 20 to 50 feet per mile in the study reach. The channel generally ranges from about 1 to 10 feet in depth and 30 to 150 feet in top width. Figures 1 through 12 on the following pages are photographs which illustrate channel conditions in the study reach. All scenes are located along Sheep Draw.

The climate is semiarid. In general, warm summers and mild to cold winters prevail. Intense thunderstorms, sometimes of cloudburst intensity, can occur during the summer months. At Greeley, adjacent to

the Sheep Draw basin, the mean annual precipitation is about 12 inches. Temperatures range from a mean of about 24° F in January to a mean of about 73° F in July. The major soil types in the basin are of the Olney-Kim-Otero or the Weld-Colby Soil associations. These are generally moderately sloping medium to moderately-coarse textured soils. Vegetation is predominantly grassland or irrigated cropland, with few trees.

The Sheep Draw basin is crossed by U.S. Highway 34, alternate Business Route U.S. Highway 34, and Colorado Highway 257. County roads are located on most section lines. The basin at present is essentially rural. However, urbanization is beginning at a few locations on the eastern edge of the basin.

The reach studied extends from the Sheep Draw confluence with the Cache la Poudre River upstream to near Colorado Highway 257, a distance of about 7 miles. Development on the flood plain within this reach is relatively sparse. The most common form of development is that associated with farmsteads and an agricultural area. At present, the more congested development associated with urban areas has not reached into the Sheep Draw flood plain. However, such development is quite close in some areas.

Figure 1. Looking downstream from County Road 62 (F Street), October 1979.

Figure 2. Looking upstream from County Road 62 (F Street), October 1979.

Table 2 Continued
Flood Plain Reference Data
Sheep Draw

Identification		Reference Number	Distance From Mouth (ft)	Stream[1] Bed Elev. (ft msl)	10-Year Flood Crest Elev. (ft msl)	10-Year Flood Peak Discharge[2] (cfs)	50-Year Flood Crest Elev. (ft msl)	50-Year Flood Peak Discharge[2] (cfs)	100-Year Flood Crest Elev. (ft msl)	100-Year Flood Peak Discharge[2] (cfs)	500-Year Flood Crest Elev. (ft msl)	500-Year Flood Peak Discharge[2] (cfs)
		93	14490	4750.0	4753.9		4755.0		4755.7		4756.9	
		92	14815	4752.6	4757.9		4758.8		4759.2		4760.1	
		91	15100	4754.3	4760.0		4761.5		4761.9		4762.9	
		90	15430	4756.7	4761.5		4762.9		4763.6		4764.8	
		89.1	15700	4759.7	4764.3		4765.4		4766.1		4767.4	
County Road 29	D/S	89	15850	4762.9	4765.5		4766.9		4767.3		4768.2	
(71st Avenue)	U/S	88.2	15930	4763.5	4770.2		4771.1		4771.6		4773.2	
		87	16245	4765.1	4770.2		4771.2		4771.7		4773.3	
		86	16590	4766.7	4770.3		4771.4		4771.9		4773.5	
		85	16885	4767.9	4770.8		4772.1		4772.8		4774.3	
		84	17270	4769.4	4772.7		4774.1		4775.0		4776.7	
		83	17625	4770.9	4774.2		4775.8		4776.7		4778.3	
		82	17920	4771.8	4774.8		4776.5		4777.5		4779.5	
		81	18265	4772.8	4775.9		4777.5		4778.5		4780.9	
Stream 23	D/S	80.1	18610			1070		2630		3890		7490
	U/S					1040		2560		3800		7310
		80	18895	4774.5	4777.9		4779.5		4780.5		4782.6	
		79	19210	4777.1	4779.8		4781.6		4782.5		4784.1	
		78	19685	4778.8	4782.8		4784.5		4785.3		4786.8	
		77	19960	4780.0	4783.5		4785.4		4786.3		4788.0	
		76	20250	4781.2	4784.9		4786.7		4787.7		4789.9	
		75	20595	4782.8	4786.6		4788.3		4789.2		4791.1	
		74	20900	4785.1	4790.5		4792.2		4793.2		4795.5	
		73	21330	4788.0	4793.4		4795.5		4796.8		4799.2	
		72	21670	4789.7	4794.8		4797.0		4798.4		4800.9	

[1] Low water elevation as determined by photogrammetric methods.

[2] Discharges are prorated between stations.

Table 2 Continued
Flood Plain Reference Data
Sheep Draw

Identification		Reference Number	Distance From Mouth (ft)	Stream[1] Bed Elev. (ft msl)	10-Year Flood Crest Elev. (ft msl)	10-Year Flood Peak Discharge[2] (cfs)	50-Year Flood Crest Elev. (ft msl)	50-Year Flood Peak Discharge[2] (cfs)	100-Year Flood Crest Elev. (ft msl)	100-Year Flood Peak Discharge[2] (cfs)	500-Year Flood Crest Elev. (ft msl)	500-Year Flood Peak Discharge[2] (cfs)
		113	6555	4715.7	4720.6		4722.1		4722.6		4723.5	
		112	7150	4719.3	4724.5		4725.9		4726.6		4728.1	
County Road 60-1/2	D/S	111.1	7200	4719.6	4724.9		4726.4		4727.3		4728.7	
(4th Street)	U/S	111.2	7310	4720.1	4725.9		4728.3		4729.5		4732.7	
		110	7720	4722.0	4726.9		4728.5		4729.6		4732.8	
		109	8115	4724.2	4729.1		4730.1		4730.4		4733.0	
		108	8495	4725.4	4730.5		4731.3		4731.8		4733.5	
		107	9275	4727.5	4732.2		4733.2		4733.6		4734.6	
		106	9710	4728.7	4733.9		4734.4		4734.7		4735.4	
		105	10075	4729.1	4735.2		4736.4		4736.8		4737.9	
		104	10445	4730.1	4735.8		4737.1		4737.7		4739.0	
		103	10760	4730.7	4736.6		4738.2		4738.9		4741.0	
		102	11195	4732.7	4738.3		4740.1		4740.8		4742.6	
		101	11755	4735.0	4740.9		4742.3		4742.9		4744.2	
U.S. Highway 34B	D/S	100	12105	4736.4	4742.8		4744.1		4744.5		4745.6	
(West 10th Street)	U/S	99.2	12245	4737.7	4742.9		4744.3		4745.1		4749.3	
		98	12495	4738.6	4744.3		4746.6		4747.6		4749.9	
Streams 17, 13, & 72	D/S	97.1	12640			1240		3110		4470		8750
	U/S					1150		2880		4150		8030
		97	12930	4741.7	4745.8		4747.5		4748.5		4750.8	
		96	13320	4742.8	4747.3		4748.3		4749.1		4751.2	
		95	13730	4744.4	4749.6		4750.7		4751.8		4753.0	
		94	14115	4747.2	4751.9		4753.9		4754.3		4755.5	
Stream 20	D/S	93.1	14400			1150		2870		4170		8040
	U/S					1070		2670		3880		7450

1/ Low water elevation as determined by photogrammetric methods.

2/ Discharges are prorated between stations.

Table 2
Flood Plain Reference Data
Sheep Draw

Identification		Reference Number	Distance From Mouth (ft)	Stream[1] Bed Elev. (ft msl)	10-Year Flood Crest Elev. (ft msl)	10-Year Flood Peak Discharge[2] (cfs)	50-Year Flood Crest Elev. (ft msl)	50-Year Flood Peak Discharge[2] (cfs)	100-Year Flood Crest Elev. (ft msl)	100-Year Flood Peak Discharge[2] (cfs)	500-Year Flood Crest Elev. (ft msl)	500-Year Flood Peak Discharge[2] (cfs)
Mouth - Confluence with			0			1280		3120		4305		8320
Cache La Poudre River		136	215	4687.9	4691.9		4692.6		4692.9		4693.4	
		135	590	4689.0	4693.2		4693.7		4694.0		4694.6	
		134	970	4689.6	4694.0		4694.5		4694.8		4695.5	
Greeley No. 3 Ditch	D/S	133	1285	4690.0	4694.9		4695.5		4695.8		4696.5	
	U/S	133.2	1400	4690.7	4696.5		4697.0		4697.3		4697.9	
		128	1430	4691.4	4697.0		4697.4		4697.6		4698.1	
		127	1900	4693.0	4698.2		4699.0		4699.4		4700.2	
		126	2300	4694.8	4698.8		4699.5		4699.9		4700.8	
		125	2685	4697.0	4702.5		4703.5		4703.8		4704.4	
		124	2875	4697.3	4703.7		4704.5		4704.9		4705.9	
County Road 62	D/S	123.1	2925	4697.3	4703.7		4704.5		4704.9		4706.0	
(F Street)	U/S	123.2	3005	4697.3	4704.6		4706.5		4706.8		4707.8	
		122	3260	4698.4	4705.2		4706.8		4707.1		4708.3	
		121	3650	4700.7	4707.3		4708.3		4709.1		4710.5	
		120	3965	4702.4	4708.5		4709.8		4710.4		4711.7	
		119	4340	4704.3	4710.4		4711.7		4712.3		4713.7	
		118	4665	4706.5	4711.7		4712.9		4713.5		4714.9	
Stream 2	D/S	117.1	4690			1280		3190		4510		8750
	U/S					1270		3160		4470		8690
		117	5095	4708.5	4713.6		4714.9		4715.5		4717.1	
		116	5415	4709.9	4715.6		4716.6		4717.0		4718.0	
		115	5710	4711.5	4717.4		4718.5		4719.0		4720.0	
		114	6065	4712.8	4718.1		4719.3		4719.8		4721.0	

1/ Low water elevation as determined by photogrammetric methods.

2/ Discharges are prorated between stations.

Table 3 shows the effect of future basin urbanization on the discharge and water surface elevation of the 100-year flood. Plates 23 through 28 display water surface elevations for the 100-year flood under existing conditions compared with projected and total urbanization conditions.

Under the projected urbanization condition, the downstream half of the basin is covered with relatively impervious areas. Projected urbanization increases flooding relative to existing conditions in the reach downstream from County Road 25. The 100-year flood increases in elevation by about 0.1 to 0.7 feet and the discharge increases range up to about 25 percent. Total urbanization increases flooding through the entire study reach. Relative to existing conditions, the 100-year flood elevation increases by about 1.0 to 3.4 feet. The discharge increases by about 100 to 120 percent.

conditions were computed assuming that the existing small irrigation dams and canals are removed but that road structures are in place with culverts unobstructed. All elevations are referenced to mean sea level from the National Geodetic Vertical Datum of 1929.

FINDINGS OF STUDY

Information regarding the more frequent floods, such as the 10-year and 50-year floods is useful for design of minor engineering works or for land use planning where a high failure risk is economically feasible and hazards to life and property are low. The 100-year flood is often used for design when a lower risk of failure is desired. Its most important use is as a standard for flood plain designation and flood plain regulation. The 500-year flood is useful to remind the public that floods larger than the 100-year flood can and do occur. The 500-year flood can also be used to regulate high risk developments in the flood plain, such as nuclear power plants or toxic material storage.

Table 2 lists the discharges and water surface elevations with existing conditions for the 10-, 50-, 100-, and 500-year flood events at selected reference points. Plates 5 through 16 show the area flooded by the 100-year and 500-year floods under existing conditions. Plates 17 through 22 show the streambed elevation and water surface profiles for the 10-, 50-, 100-, and 500-year floods under existing conditions.

The flood boundaries were located at each cross section and the intervening flood boundaries were drawn based upon detailed topographic mapping, engineering judgment, and field observations. It is, however, possible that more or less flooding should be shown on the flooded area maps. For a specific situation, where more detailed accuracy is required, the flood boundaries can be more accurately established by determining the water surface elevation from the profile or reference table and then locating that elevation by survey on the flood plain.

sections were placed at close intervals upstream and downstream from bridges and culverts in order to compute the significant backwater effects of these structures. Bridge cross sections were field surveyed to determine elevation data and structure geometry. The locations of the cross sections are shown on the flooded area maps. Plate 4 is an index which shows the location of the flooded area maps, plates 5 through 16. The cross section locations are also designated on the flood profiles, which are plates 17 through 28.

Manning's "n" values were estimated by field inspection to be 0.035 to 0.040 for the channel and 0.040 - 0.100 for the overbank. Starting water surface elevations at the mouth of Sheep Draw were based on Sheep Draw flooding with a coincident base flow of 1,100 cubic feet per second (c.f.s.) in the Cache la Poudre River. The water surface elevation of the Cache la Poudre River was determined by analyzing stage-discharge relationships for the Cache la Poudre River from Flood Plain Information, Cache la Poudre River, Colorado, Volume II, Greeley, Weld County, published by the Omaha District Corps of Engineers in March 1974. Water surface elevations on Sheep Draw were computed by the Corps of Engineers' standard step backwater computer program, HEC-2. The effect of bridges, culverts, and roadways upon Sheep Draw flood water surface elevations was determined by using bridge analysis techniques contained in the HEC-2 computer program and a publication entitled Hydraulics of Bridge Waterways, published by the U.S. Department of Transportation in 1970. Flood reconstitution was not conducted because of a lack of flood history.

All flood elevations are based upon open channel conditions free of debris or ice. The flood elevations shown are, therefore, considered valid only if hydraulic structures, in general, remain unobstructed. Since some obstruction is common during floods, flood conditions could be worse than shown. As discussed in the hydrologic analysis, the flood discharges for both existing and urbanized

probability adjustments to rainfall were made for length of record. The time distribution of rainfall within the 1-hour storm was developed from NOAA criteria. Infiltration rates were obtained from a Weld County Soil Map and Soil Resources of Colorado, Region 2-Larimer and Weld Counties, published by the Colorado State University Experiment Station and the SCS in 1976. A value of 0.2 inch was used for detention storage.

The effect of future urbanization, existing small dams, road structures, and irrigation canals was considered. It was assumed that irrigation canals do not provide dependable flood control. Similarly, since the small dams which exist in the basin serve irrigation, the assumption was made by local interests that these dams would not remain if the area were urbanized. Roadways that cross the Sheep Draw valley are relatively high and act to retard floodflows. Because of these factors and assumptions, the decision was made at the local level to exclude the effect of the irrigation canals and the small irrigation dams from this study under both existing and urbanized conditions but to include the effect of the roadways.

HYDRAULIC ANALYSIS

The hydraulic analysis was conducted on Sheep Draw to determine the water surface elevation of the 10-, 50-, 100-, and 500-year floods. Topographic mapping consisted of orthophoto maps at a scale of 1:2400 and a contour interval of 2 feet and USGS 7.5-Minute Quadrangle mapping having a scale of 1:24,000 and a contour interval of 10 feet. The orthophoto mapping was prepared for Weld County, Colorado, and the CWCB by M&I Consulting Engineers of Fort Collins, Colorado. The photography was taken on 20 December 1977. The mapping was prepared in December 1978. A total of 136 cross sections were taken by photogrammetric methods. The streambed elevation derived from the cross sections is actually the low-water profile. However, stream flow was minimal at the time the photography for the mapping was taken. Stream cross

Table 1
Percent of Imperviousness for Land Uses
in the Sheep Draw Basin

Land Use	Impervious Area (percent)
Commercial	90
Medium Density Residential	40
Agricultural	5

The land use patterns were slightly altered to fit hydrologic subareas in the hydrologic model. To depict urban land use as actually used in the hydrologic model, areas with approximately 40 percent or more imperviousness are indicated on plate 3. Any changes in these land use projections and future urbanization boundaries would change the hydrologic and hydraulic data presented in this study.

HYDROLOGIC ANALYSIS

A hydrologic analysis was carried out to establish the peak discharges for floods of various frequencies. Floods with 10-, 50-, 100-, and 500-year recurrence intervals are presented in this report. A detailed description of the hydrologic analysis is contained in Volume II of this study.

Stream gaging records are not available for Sheep Draw. EPA's SWMM was used to model rainfall - runoff characteristics of the basin. Basin characteristics needed for the model were taken from U.S. Geological Survey (USGS) 7.5-Minute Quadrangle mapping having a scale of 1:24,000 with a contour interval of 10 feet. Rainfall values for 1-hour storm events of various frequency were obtained from the Precipitation-Frequency Atlas of the Western United States, Atlas 2, Volume III, Colorado, published by the National Oceanic and Atmospheric Administration (NOAA) in 1973. The 500-year rainfall value was extrapolated from the 100-year and more frequent events. Expected

FLOOD PROBLEMS

Flood history is not readily available for Sheep Draw as the basin has been sparsely developed. Flood experience in the area indicates that snowmelt flooding is uncommon and that summer cloudbursts would be the most likely source of flooding. Flood damages are also possible in the event of large amounts of runoff from tributaries or small drainageways flowing into Sheep Draw. There are no flood control works in the basin. Small irrigation dams, irrigation canals, and road crossing structures provide some incidental flood discharge reduction, as discussed in the hydrologic analysis.

ALTERNATIVE LAND USE CONDITIONS

The Sheep Draw flood hazard was evaluated under future as well as existing conditions since the Sheep Draw basin is subject to increasing urban development. Changes in imperviousness that would result from land use changes will affect the runoff potential. To reflect the influence of changing development, three levels of urbanization were considered. Existing and future urbanization are shown on plate 3. Two of these urbanization levels, existing and projected, are shown in the report entitled Larimer-Weld Region Land Use Alternatives prepared for the Larimer-Weld Regional Council of Governments in November 1977. The existing urbanization reflects no significant urban development. Projected urbanization is based upon year 2000 land use. This level of urbanization represents an intermediate level of development in that the downstream half of the Sheep Draw basin is urbanized. Total urbanization assumes the entire basin is urbanized.

The percent of imperviousness for the land areas was estimated for existing, projected urbanization, and total urbanization conditions. Table 1 lists the percent of imperviousness for each land use that was considered in the hydrologic model.

Figure 11. Looking downstream from U.S. Highway 34, October 1979.

Figure 12. Looking upstream from U.S. Highway 34, October 1979.

Figure 9. Looking downstream from the County Road 58 bridge at at a point 400 feet east of the intersection of County Road 58 and County Road 25, October 1979.

Figure 10. Looking upstream from County Road 25 (95th Avenue), October 1979.

Figure 7. Looking downstream from County Road 29 (71st Avenue), October 1979.

Figure 8. Looking downstream from County Road 27 (83rd Avenue), October 1979.

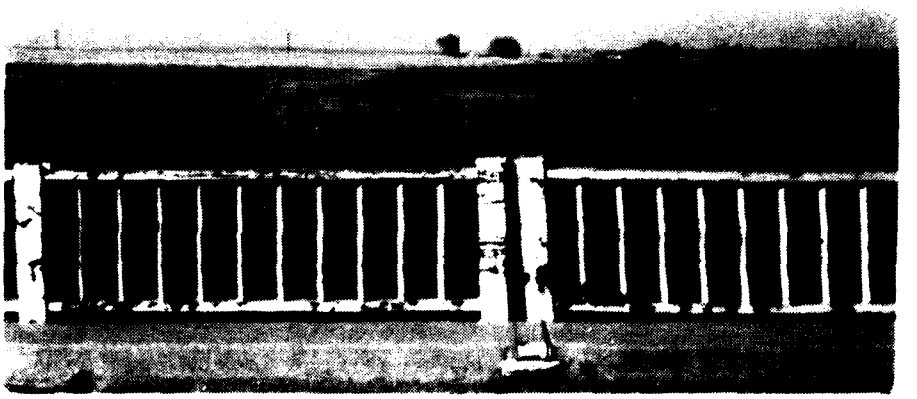

Figure 5. Looking downstream from alternate Business Route U.S. Highway 34, October 1979.

Figure 6. Looking upstream from alternate Business Route U.S. Highway 34, October 1979.

Figure 3. Looking downstream from County Road 60½ (4th Street), October 1979.

Figure 4. Typical flood plain scene looking east at the County Road 60½ crossing of Sheep Draw, October 1979.

Table 2 Continued
Flood Plain Reference Data
Sheep Draw

Identification		Reference Number	Distance From Mouth (ft)	Stream[1] Bed Elev. (ft msl)	10-Year Flood Crest Elev. (ft msl)	10-Year Flood Peak Discharge[2] (cfs)	50-Year Flood Crest Elev. (ft msl)	50-Year Flood Peak Discharge[2] (cfs)	100-Year Flood Crest Elev. (ft msl)	100-Year Flood Peak Discharge[2] (cfs)	500-Year Flood Crest Elev. (ft msl)	500-Year Flood Peak Discharge[2] (cfs)
		71	21920	4790.8	4796.2		4798.2		4799.4		4801.5	
		70	22340	4793.3	4797.8		4800.1		4801.5		4804.2	
County Road 27	D/S	69.1	22380	4793.6	4798.0		4800.2		4801.6		4804.3	
(83rd Avenue)	U/S	68	22485	4795.0	4799.1		4800.8		4804.7		4806.3	
		67	22700	4796.2	4801.2		4803.3		4805.0		4806.8	
		66	22990	4797.4	4801.8		4804.0		4805.7		4808.1	
		65	23275	4799.0	4802.5		4804.4		4805.9		4808.2	
		64	23610	4800.6	4805.1		4806.5		4807.3		4809.3	
		63	23920	4801.1	4805.9		4807.7		4808.7		4810.6	
		62	24210	4802.0	4806.9		4808.8		4809.9		4811.9	
		61	24550	4803.7	4808.4		4810.6		4811.9		4814.1	
		60	24860	4806.5	4810.2		4812.0		4813.1		4815.1	
		59	25250	4808.7	4813.3		4815.0		4816.0		4817.6	
		58	25595	4811.7	4815.7		4817.7		4818.9		4821.3	
North Boomerang	D/S	57.1	25920	4814.8	4817.9		4819.5		4820.6		4822.5	
Ditch Extension	U/S	57.2	25930	4815.2	4818.3		4820.0		4821.1		4824.4	
		56	26000	4816.3	4819.8		4821.3		4822.2		4824.4	
		55	26320	4819.8	4823.8		4825.2		4826.0		4827.7	
		54	26385	4821.4	4826.5		4828.6		4829.7		4831.0	
		53.1	26425	4821.9	4828.2		4830.3		4831.2		4832.8	
		53	26465	4821.9	4828.2		4830.3		4831.2		4832.8	
		52	26825	4821.8	4828.3		4830.4		4831.4		4833.2	
		51	27190	4821.8	4828.4		4830.5		4831.5		4833.3	
		50	27520	4824.0	4829.2		4831.6		4833.0		4835.1	
		49	27810	4825.6	4830.3		4832.1		4833.3		4835.5	

1/ Low water elevation as determined by photogrammetric methods.

2/ Discharges are prorated between stations.

Table 2 Continued
Flood Plain Reference Data
Sheep Draw

Identification		Reference Number	Distance From Mouth (ft)	Stream[1] Bed Elev. (ft msl)	10-Year Flood Crest Elev. (ft msl)	10-Year Flood Peak Discharge[2] (cfs)	50-Year Flood Crest Elev. (ft msl)	50-Year Flood Peak Discharge[2] (cfs)	100-Year Flood Crest Elev. (ft msl)	100-Year Flood Peak Discharge[2] (cfs)	500-Year Flood Crest Elev. (ft msl)	500-Year Flood Peak Discharge[2] (cfs)
		48	28165	4827.4	4832.3		4834.1		4835.3		4836.9	
		47	28740	4833.3	4838.6		4840.9		4842.1		4843.8	
County Road 25	D/S	46.1	28885	4835.7	4840.6		4842.0		4843.6		4846.8	
(95th Avenue)			28900			960		2330		3650		6610
						770		1950		2910		5210
	U/S	46.2	29005	4836.7	4841.7		4851.0		4851.9		4853.8	
		45	29075	4836.9	4842.0		4851.1		4852.0		4853.9	
		44	29255	4837.8	4842.3		4851.1		4852.0		4853.9	
U.S. Highway 34	D/S	43.1	29435	4839.0	4844.0		4851.1		4852.0		4853.9	
			29490			720		1830		2690		4850
						720		1940		2690		4860
	U/S	43.2	29560	4840.2	4845.0		4852.6		4852.9		4854.1	
		42	29660	4840.4	4846.0		4852.6		4852.9		4854.2	
		41	29970	4843.1	4847.8		4852.7		4853.0		4854.4	
		40	30275	4845.0	4850.7		4853.4		4854.2		4856.0	
Culvert	D/S	39.1	30410	4845.5	4851.2		4853.5		4854.3		4856.1	
	U/S	39.2	30450	4846.1	4851.4		4853.7		4854.5		4856.3	
		38	30605	4847.4	4852.2		4854.0		4854.8		4856.5	
		37	30940	4849.3	4853.9		4855.7		4856.1		4857.5	
Culvert	D/S	36.1	31125	4851.9	4856.5		4857.9		4858.3		4859.1	
	U/S	36.2	31175	4852.5	4857.2		4858.4		4858.8		4859.8	
		35	31230	4853.1	4857.6		4858.5		4858.9		4859.9	
		34	31580	4856.4	4859.7		4860.6		4860.9		4861.6	
		33	31775	4857.0	4860.8		4861.4		4861.7		4862.4	
		32	32070	4858.3	4862.6		4863.6		4864.0		4864.8	

1/ Low water elevation as determined by photogrammetric methods.

2/ Discharges are prorated between stations.

Table 2 Continued
Flood Plain Reference Data
Sheep Draw

Identification		Reference Number	Distance From Mouth (ft)	Stream[1] Bed Elev. (ft msl)	10-Year Flood Crest Elev. (ft msl)	10-Year Flood Peak Discharge[2] (cfs)	50-Year Flood Crest Elev. (ft msl)	50-Year Flood Peak Discharge[2] (cfs)	100-Year Flood Crest Elev. (ft msl)	100-Year Flood Peak Discharge[2] (cfs)	500-Year Flood Crest Elev. (ft msl)	500-Year Flood Peak Discharge[2] (cfs)
		31	32410	4861.3	4864.5		4865.4		4865.8		4866.8	
		30	32670	4863.7	4868.2		4869.2		4869.6		4870.4	
Culvert	D/S	29.1	32695	4864.0	4868.5		4869.6		4870.0		4870.8	
	U/S	29.2	32760	4865.0	4869.6		4870.7		4871.1		4872.2	
		28	33035	4868.9	4872.7		4873.5		4873.9		4874.5	
Stream 51	D/S	27.2	33250			670		1750		2450		4390
	U/S					550		1460		2050		3670
		27	33495	4871.4	4875.6		4876.6		4877.1		4878.1	
		26	33850	4874.9	4878.4		4879.6		4880.0		4880.9	
		25	34125	4877.2	4881.1		4882.1		4882.5		4883.4	
Culvert	D/S	24.1	34160	4877.4	4881.4		4882.4		4882.9		4884.0	
	U/S	24.2	34200	4878.0	4883.1		4884.2		4884.6		4885.6	
Reservoir	D/S	23	34580	4881.8	4884.5		4885.4		4885.9		4886.8	
	U/S	22.2	34710	4885.5	4895.5		4896.5		4896.8		4897.5	
Streams 56 & 59	D/S	21	34800			540		1450		2050		3650
	U/S					370		1020		1450		2560
		17	35020	4885.5	4895.5		4896.5		4896.8		4897.5	
		16	35320	4887.1	4895.5		4896.5		4896.8		4897.5	
		15	35630	4888.6	4895.5		4896.5		4896.8		4897.6	
		14	35940	4889.8	4895.5		4896.6		4896.9		4897.7	
		13	36410	4895.2	4896.9		4898.1		4898.7		4900.0	
Stream 62	D/S	12.1	36450			360		1010		1440		2520
	U/S					270		770		1110		1930
		12	36795	4898.5	4901.0		4902.1		4902.6		4903.7	
		11	37150	4902.1	4903.6		4904.7		4905.2		4906.3	

1/ Low water elevation as determined by photogrammetric methods.

2/ Discharges are prorated between stations.

Table 2 Continued
Flood Plain Reference Data
Sheep Draw

Identification	Reference Number	Distance From Mouth (ft)	Stream[1] Bed Elev. (ft msl)	10-Year Flood		50-Year Flood		100-Year Flood		500-Year Flood	
				Crest Elev. (ft msl)	Peak Discharge[2] (cfs)	Crest Elev. (ft msl)	Peak Discharge[2] (cfs)	Crest Elev. (ft msl)	Peak Discharge[2] (cfs)	Crest Elev. (ft msl)	Peak Discharge[2] (cfs)
	10	37590	4907.1	4909.0		4909.9		4910.2		4911.0	
	9	38105	4912.5	4914.0		4915.0		4915.5		4916.3	
	8	38375	4915.8	4917.0		4917.8		4918.1		4918.9	
	7	38590	4918.2	4919.5		4920.4		4920.8		4921.8	
	6	38895	4921.5	4922.8		4923.9		4924.5		4925.5	
	5	39115	4923.7	4926.1		4927.4		4928.0		4929.0	
	4	39390	4927.7	4930.0		4931.2		4931.7		4932.7	
Streams 68 & 71 D/S		39400			250		730		1050		1790
Upstream Limit of Study											

1/ Low water elevation as determined by photogrammetric methods.

2/ Discharges are prorated between stations.

Table 3
Effect of Land Use on Flood Elevations and Discharges
Sheep Draw

Identification	Reference Number	Distance From Mouth (ft)	Stream[1] Bed Elev. (ft msl)	Existing Conditions 100-Year Flood Crest Elev. (ft msl)	Existing Conditions 100-Year Flood Peak Discharge[2] (cfs)	Projected Urbanization 100-Year Flood Crest Elev. (ft msl)	Projected Urbanization 100-Year Flood Peak Discharge[2] (cfs)	Total Urbanization 100-Year Flood Crest Elev. (ft msl)	Total Urbanization 100-Year Flood Peak Discharge[2] (cfs)
Mouth - Confluence with		0			4305		5390		8470
Cache la Poudre River	136	215	4687.9	4692.9		4693.1		4693.4	
	135	590	4689.0	4694.0		4694.2		4694.7	
	134	970	4689.6	4694.8		4695.0		4695.5	
Greeley No. 3 Ditch	D/S 133	1285	4690.0	4695.8		4696.0		4696.5	
	U/S 133.2	1400	4690.7	4697.3		4697.5		4697.9	
	128	1430	4691.4	4697.6		4697.7		4698.1	
	127	1900	4693.0	4699.4		4699.6		4700.3	
	126	2300	4694.8	4699.9		4700.1		4700.8	
	125	2685	4697.0	4703.8		4704.0		4704.4	
	124	2875	4697.3	4704.9		4705.2		4705.9	
County Road 62	D/S 123.1	2925	4697.3	4704.9		4705.2		4706.0	
(F Street)	U/S 123.2	3005	4697.3	4706.8		4707.1		4707.9	
	122	3260	4698.4	4707.1		4707.5		4708.3	
	121	3650	4700.7	4709.1		4709.6		4710.6	
	120	3965	4702.4	4710.4		4710.8		4711.8	
	119	4340	4704.3	4712.3		4712.8		4713.8	
	118	4665	4706.5	4713.5		4713.9		4714.9	
Stream 2	D/S 117.1	4690			4510		5760		9070
	U/S				4470		5680		9020
	117	5095	4708.5	4715.5		4716.1		4717.2	
	116	5415	4709.9	4717.0		4717.3		4718.1	
	115	5710	4711.5	4719.0		4719.3		4720.1	
	114	6065	4712.8	4719.8		4720.2		4721.0	

[1]Low water elevation as determined by aerial photogrammetric methods.
[2]Discharges are prorated between stations.

Table 3 (Cont'd)
Effect of Land Use on Flood Elevations and Discharges
Sheep Draw

Identification		Reference Number	Distance From Mouth (ft)	Stream[1] Bed Elev. (ft msl)	Existing Conditions 100-Year Flood Crest Elev. (ft msl)	Existing Conditions 100-Year Flood Peak Discharge[2] (cfs)	Projected Urbanization 100-Year Flood Crest Elev. (ft msl)	Projected Urbanization 100-Year Flood Peak Discharge[2] (cfs)	Total Urbanization 100-Year Flood Crest Elev. (ft msl)	Total Urbanization 100-Year Flood Peak Discharge[2] (cfs)
		113	6555	4715.7	4722.6		4722.8		4723.6	
		112	7150	4719.3	4726.6		4727.1		4728.2	
County Road 60-1/2	D/S	111.1	7200	4719.6	4727.3		4727.7		4728.9	
(4th Street)	U/S	111.2	7310	4720.1	4729.5		4730.5		4733.0	
		110	7720	4722.0	4729.6		4730.6		4733.1	
		109	8115	4724.2	4730.4		4731.1		4733.2	
		108	8495	4725.4	4731.8		4732.2		4733.7	
		107	9275	4727.5	4733.6		4733.9		4734.7	
		106	9710	4728.7	4734.7		4734.9		4735.5	
		105	10075	4729.1	4736.8		4737.2		4738.0	
		104	10445	4730.1	4737.7		4738.1		4739.1	
		103	10760	4730.7	4738.9		4739.5		4741.2	
		102	11195	4732.7	4740.8		4741.4		4742.7	
		101	11755	4735.0	4742.9		4743.2		4744.3	
U.S. Highway 34B	D/S	100	12105	4736.4	4744.5		4744.8		4745.7	
(West 10th Street)	U/S	99.2	12245	4737.7	4745.1		4745.7		4749.8	
		98	12495	4738.6	4747.6		4748.3		4750.3	
Stream 17, 13, & 72	D/S	97.1	12640			4470		5620		9290
	U/S					4150		4560		8730
		97	12930	4741.7	4748.5		4749.2		4751.1	
		96	13320	4742.8	4749.1		4749.6		4751.6	
		95	13730	4744.4	4751.8		4752.0		4753.0	
		94	14115	4747.2	4754.3		4754.5		4755.8	
Stream 20	D/S	93.1	14400			4170		4570		8780
	U/S					3880		4250		8200

1/Low water elevation as determined by aerial photogrammetric methods.
2/Discharges are prorated between stations.

Table 3 (Cont'd)
Effect of Land Use on Flood Elevations and Discharges
Sheep Draw

Identification	Reference Number	Distance From Mouth (ft)	Stream[1] Bed Elev. (ft msl)	Existing Conditions 100-Year Flood		Projected Urbanization 100-Year Flood		Total Urbanization 100-Year Flood	
				Crest Elev. (ft msl)	Peak Discharge[2] (cfs)	Crest Elev. (ft msl)	Peak Discharge[2] (cfs)	Crest Elev. (ft msl)	Peak Discharge[2] (cfs)
	93	14490	4750.0	4755.7		4755.8		4757.2	
	92	14815	4752.6	4759.2		4759.4		4760.2	
	91	15100	4754.3	4761.9		4762.0		4763.1	
	90	15430	4756.7	4763.6		4763.8		4765.0	
	89.1	15700	4759.7	4766.1		4766.3		4767.7	
County Road 29	D/S 89	15850	4762.9	4767.3		4767.4		4768.6	
(71st Avenue)	U/S 88.2	15930	4763.5	4771.6		4771.8		4773.6	
	87	16245	4765.1	4771.7		4771.9		4773.7	
	86	16590	4766.7	4771.9		4772.2		4773.9	
	85	16885	4767.9	4772.8		4773.0		4774.7	
	84	17270	4769.4	4775.0		4775.2		4777.0	
	83	17625	4770.9	4776.7		4776.8		4778.6	
	82	17920	4771.8	4777.5		4777.7		4779.9	
	81	18265	4772.8	4778.5		4778.8		4781.4	
Stream 23	D/S 80.1	18610			3890		4230		8440
	U/S				3800		4140		8270
	80	18895	4774.5	4780.5		4780.7		4783.1	
	79	19210	4777.1	4782.5		4782.7		4784.4	
	78	19685	4778.8	4785.3		4785.5		4787.1	
	77	19960	4780.0	4786.3		4786.5		4788.3	
	76	20250	4781.2	4787.7		4788.0		4790.5	
	75	20595	4782.8	4789.2		4789.4		4791.5	
	74	20900	4785.1	4793.2		4793.4		4796.0	
	73	21330	4788.0	4796.8		4797.1		4799.8	
	72	21670	4789.7	4798.4		4798.7		4801.4	

[1]/Low water elevation as determined by aerial photogrammetric methods.
[2]/Discharges are prorated between stations.

Table 3 (Cont'd)
Effect of Land Use on Flood Elevations and Discharges
Sheep Draw

Identification	Reference Number	Distance From Mouth (ft)	Stream[1] Bed Elev. (ft msl)	Existing Conditions 100-Year Flood		Projected Urbanization 100-Year Flood		Total Urbanization 100-Year Flood	
				Crest Elev. (ft msl)	Peak Discharge[2] (cfs)	Crest Elev. (ft msl)	Peak Discharge[2] (cfs)	Crest Elev. (ft msl)	Peak Discharge[2] (cfs)
	71	21920	4790.8	4799.4		4799.6		4801.9	
	70	22340	4793.3	4801.5		4801.8		4804.9	
County Road 27	D/S 69.1	22380	4793.6	4801.6		4801.9		4805.0	
(83rd Avenue)	U/S 68	22485	4795.0	4804.7		4804.9		4806.7	
	67	22700	4796.2	4805.0		4805.2		4807.2	
	66	22990	4797.4	4805.7		4806.0		4808.7	
	65	23275	4799.0	4805.9		4806.1		4808.7	
	64	23610	4800.6	4807.3		4807.5		4809.8	
	63	23920	4801.1	4808.7		4808.8		4811.0	
	62	24210	4802.0	4809.9		4810.1		4812.3	
	61	24550	4803.7	4811.[illegible]		4812.1		4814.7	
	60	24860	4806.5	4813.1		4813.3		4815.6	
	59	25250	4808.7	4816.0		4816.2		4818.0	
	58	25595	4811.7	4818.9		4819.1		4821.9	
North Boomerang	D/S 57.1	25920	4814.8	4820.6		4820.8		4823.1	
Ditch Extension	U/S 57.2	25930	4815.2	4821.1		4821.3		4825.5	
	56	26000	4816.3	4822.2		4822.3		4825.6	
	55	26320	4819.8	4826.0		4826.1		4828.1	
	54	26385	4821.4	4829.7		4829.8		4831.3	
	53.1	26425	4821.9	4831.2		4831.3		4833.2	
	53	26465	4821.9	4831.2		4831.3		4833.3	
	52	26825	4821.8	4831.4		4831.5		4833.7	
	51	27190	4821.8	4831.5		4831.7		4833.8	
	50	27520	4824.0	4833.0		4833.2		4835.6	
	49	27810	4825.6	4833.3		4833.5		4836.0	

[1]/Low water elevation as determined by aerial photogrammetric methods.

[2]/Discharges are prorated between stations.

Table 3 (Cont'd)
Effect of Land Use on Flood Elevations and Discharges
Sheep Draw

Identification	Reference Number	Distance From Mouth (ft)	Stream[1] Bed Elev. (ft msl)	Existing Conditions 100-Year Flood		Projected Urbanization 100-Year Flood		Total Urbanization 100-Year Flood	
				Crest Elev. (ft msl)	Peak Discharge[2] (cfs)	Crest Elev. (ft msl)	Peak Discharge[2] (cfs)	Crest Elev. (ft msl)	Peak Discharge[2] (cfs)
	48	28165	4827.4	4835.3		4835.5		4837.3	
	47	28740	4833.3	4842.1		4842.3		4844.2	
County Road 25	D/S 46.1	28885	4835.7	4843.6		4843.8		4847.5	
(95th Avenue)		28900			3650		3820		7650
					2910		2960		6090
	U/S 46.2	29005	4836.7	4851.9		4852.0		4854.0	
	45	29075	4836.9	4852.0		4852.0		4854.1	
	44	29255	4837.8	4852.0		4852.0		4854.1	
U.S. Highway 34	D/S 43.1	29435	4839.0	4852.0		4852.0		4854.1	
		29490			2690		2690		5660
					2690		2690		5670
	U/S 43.2	29560	4840.2	4852.9		4852.9		4854.3	
	42	29660	4840.4	4852.9		4852.9		4854.4	
	41	29970	4843.1	4853.0		4853.0		4854.7	
	40	30275	4845.0	4854.2		4854.2		4856.6	
Culvert	D/S 39.1	30410	4845.5	4854.3		4854.3		4856.6	
	U/S 39.2	30450	4846.1	4854.5		4854.5		4856.8	
	38	30605	4847.4	4854.8		4854.8		4857.0	
	37	30940	4849.3	4856.1		4856.1		4858.0	
Culvert	D/S 36.1	31125	4851.9	4858.3		4858.3		4859.3	
	U/S 36.2	31175	4852.5	4858.8		4858.8		4860.1	
	35	31230	4853.1	4858.9		4858.9		4860.3	
	34	31580	4856.4	4860.9		4860.9		4861.9	
	33	31775	4857.0	4861.7		4861.7		4862.6	
	32	32070	4858.3	4864.0		4864.0		4865.0	

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Table 3 (Cont'd)
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Sheep Draw

Identification		Reference Number	Distance From Mouth (ft)	Stream[1] Bed Elev. (ft msl)	Existing Conditions 100-Year Flood		Projected Urbanization 100-Year Flood		Total Urbanization 100-Year Flood	
					Crest Elev. (ft msl)	Peak Discharge[2] (cfs)	Crest Elev. (ft msl)	Peak Discharge[2] (cfs)	Crest Elev. (ft msl)	Peak Discharge[2] (cfs)
		31	32410	4861.3	4865.8		4865.8		4867.3	
		30	32670	4863.7	4869.6		4869.6		4870.8	
Culvert	D/S	29.1	32695	4864.0	4870.0		4870.0		4871.1	
	U/S	29.2	32760	4865.0	4871.1		4871.1		4872.7	
		28	33035	4868.9	4873.9		4873.9		4874.8	
Stream 51	D/S	27.2	33250			2450		2450		5240
	U/S					2050		2050		4480
		27	33495	4871.4	4877.1		4877.1		4878.4	
		26	33850	4874.9	4880.0		4880.0		4881.2	
		25	34125	4877.2	4882.5		4882.5		4883.8	
Culvert	D/S	24.1	34160	4877.4	4882.9		4882.9		4884.4	
	U/S	24.2	34200	4878.0	4884.6		4884.6		4886.0	
Reservoir	D/S	23	34580	4881.8	4885.9		4885.9		4887.2	
	U/S	22.2	34710	4885.5	4896.8		4896.8		4897.8	
Streams 56 & 59	D/S	21	34800			2050		2050		4480
	U/S					1450		1450		3050
		17	35020	4885.5	4896.8		4896.8		4897.8	
		16	35320	4887.1	4896.8		4896.8		4897.8	
		15	35630	4888.6	4896.8		4896.8		4897.9	
		14	35940	4889.8	4896.9		4896.9		4898.0	
		13	36410	4895.2	4898.7		4898.7		4900.4	
Stream 62	D/S	12.1	36450			1440		1440		3050
	U/S					1110		1110		2310
		12	36795	4898.5	4902.6		4902.6		4904.0	
		11	37150	4902.1	4905.2		4905.2		4906.7	
		10	37590	4907.1	4910.2		4910.2		4911.3	

[1] Low water elevation as determined by aerial photogrammetric methods.
[2] Discharges are prorated between stations.

Table 3 (Cont'd)
Effect of Land Use on Flood Elevations and Discharges
Sheep Draw

Identification	Reference Number	Distance From Mouth (ft)	Stream[1] Bed Elev. (ft msl)	Existing Conditions 100-Year Flood		Projected Urbanization 100-Year Flood		Total Urbanization 100-Year Flood	
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	9	38105	4912.5	4915.5		4915.5		4916.6	
	8	38375	4915.8	4918.1		4918.1		4919.2	
	7	38590	4918.2	4920.8		4920.8		4922.2	
	6	38895	4921.5	4924.5		4924.5		4925.9	
	5	39115	4923.7	4928.0		4928.0		4929.4	
	4	39390	4927.7	4931.7		4931.7		4933.1	
Streams 68 & 71	D/S	39400			1050		1050		2170
Upstream Limit of Study									

[1]/Low water elevation as determined by aerial photogrammetric methods.
[2]/Discharges are prorated between stations.

APPENDIX A

GLOSSARY

APPENDIX A

GLOSSARY

Basin Characteristics

Characteristics of a watershed that affect the relationship between rainfall and runoff. Characteristics taken from a topographic map might include size and shape of the basin, overland slopes, stream slopes, and the arrangement of tributaries. Other characteristics might include soil and vegetation.

Coincident Flow

The water level on a stream being studied may be affected by the flow on another stream which joins with the study stream. An assumption must be made of the flow occurring in the other stream when the study stream is delivering its peak discharge.

Confluence

The point where two or more streams join.

Cross Section

A surveyed line that is generally perpendicular to the direction of the stream flow. It is used to show the topography of the flood plain and the channel.

Detention Storage

The amount of rainfall and/or rainfall runoff which is intercepted by ditches, ponds, or natural depressions and is therefore removed from the normal surface-runoff pattern.

Discharge-Probability Relationship

The chances (see "Probability") of floods of different magnitudes occurring at a given location. Smaller floods are likely to occur more often, while greater floods are less common.

Existing Conditions

In this report, this refers to the present extent of urbanization in the Sheep Draw basin. Also under this condition the irrigation canals and the small irrigation dams were assumed to be removed. Roadways were assumed to remain in place.

Expected Probability

An adjustment for the skewed distribution of the sample error around the true population.

Flood

An overflow on lands that are not normally covered by water and that can be used by man. Floods have two essential characteristics: the inundation of land is temporary; and the land is adjacent to and inundated by overflow from a river, stream, ocean, lake, or other body of standing water.

Flood Boundaries

The outer limits of the flooded area for a particular flood, as seen on an aerial photograph or a map. The flood may be an assumed flood of a given discharge or a given chance of occurrence. It may also be drawn for a flood that has already taken place.

Flood Crest

The maximum stage or elevation reached by the waters of a flood at a given location.

Flood Hazard Areas

Generally refers to the area subject to floods up to some specified magnitude.

National Flood Insurance Program

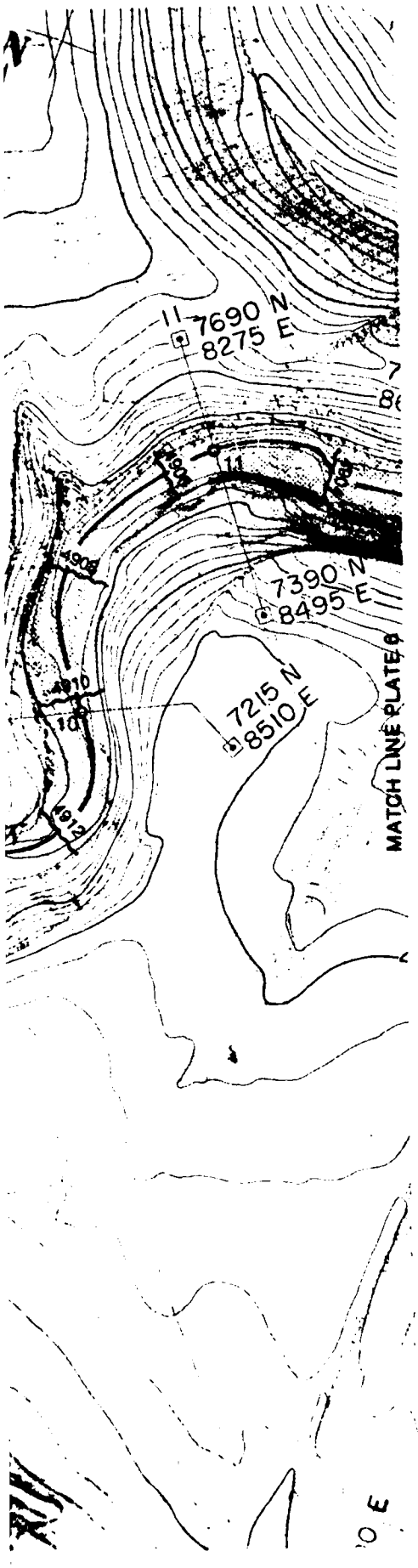
The Federal Emergency Management Agency (FEMA) has identified flood-prone communities and administers the National Flood Insurance Program (NFIP). Communities that agree to join the NFIP adopt minimum standards to mitigate flood losses. In return, the Federal Government makes flood insurance available to property owners at subsidized rates. Loans or guarantees by Federal agencies for construction are not available in flood hazard areas that are in non-NFIP flood-prone communities.

Flood Plain

The relatively flat area or lowlands adjoining the channel of a river, stream, watercourse, ocean, lake, or other body of standing water which has been or may be covered by floodwater.

Flood Profile

A graph showing the relationship of water surface elevation to location, the latter generally expressed as the distance upstream from the mouth for a stream of water flowing in an open channel. A flood



LEGEND:

500 YEAR FLOOD
100 YEAR FLOOD

4846 — 100 Year Flood Elevation Line in Feet M.S.L.

27 — Reference Point — Also locations of surveyed cross sections

NOTES:

1. For the location of this plate, see Plate Index Map (Plate 4).
2. For Profile, see Plates 17-22.
3. For flood elevations at the reference points, see Table 2.
4. Flooded areas represent existing conditions.

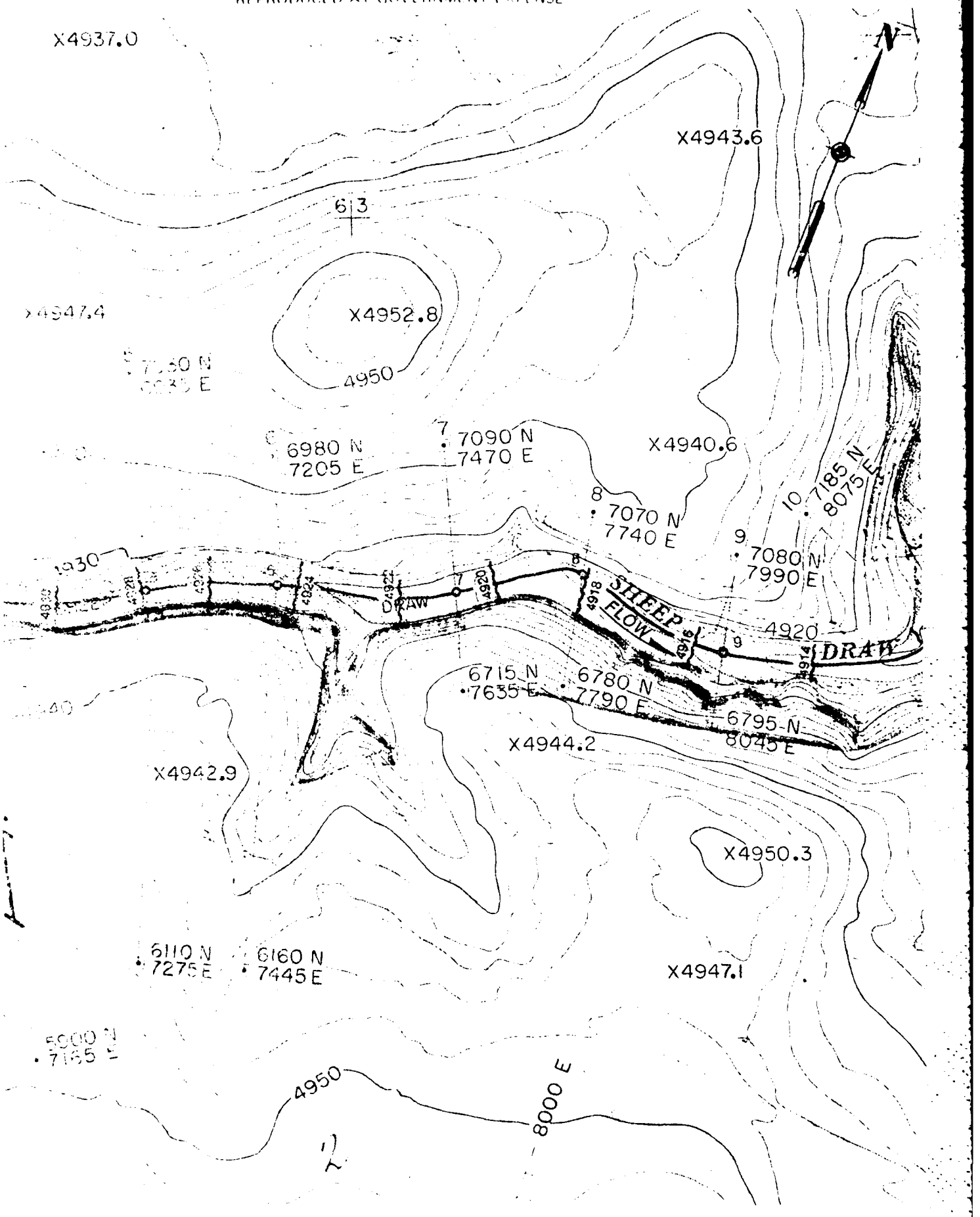
SCALE IN FEET

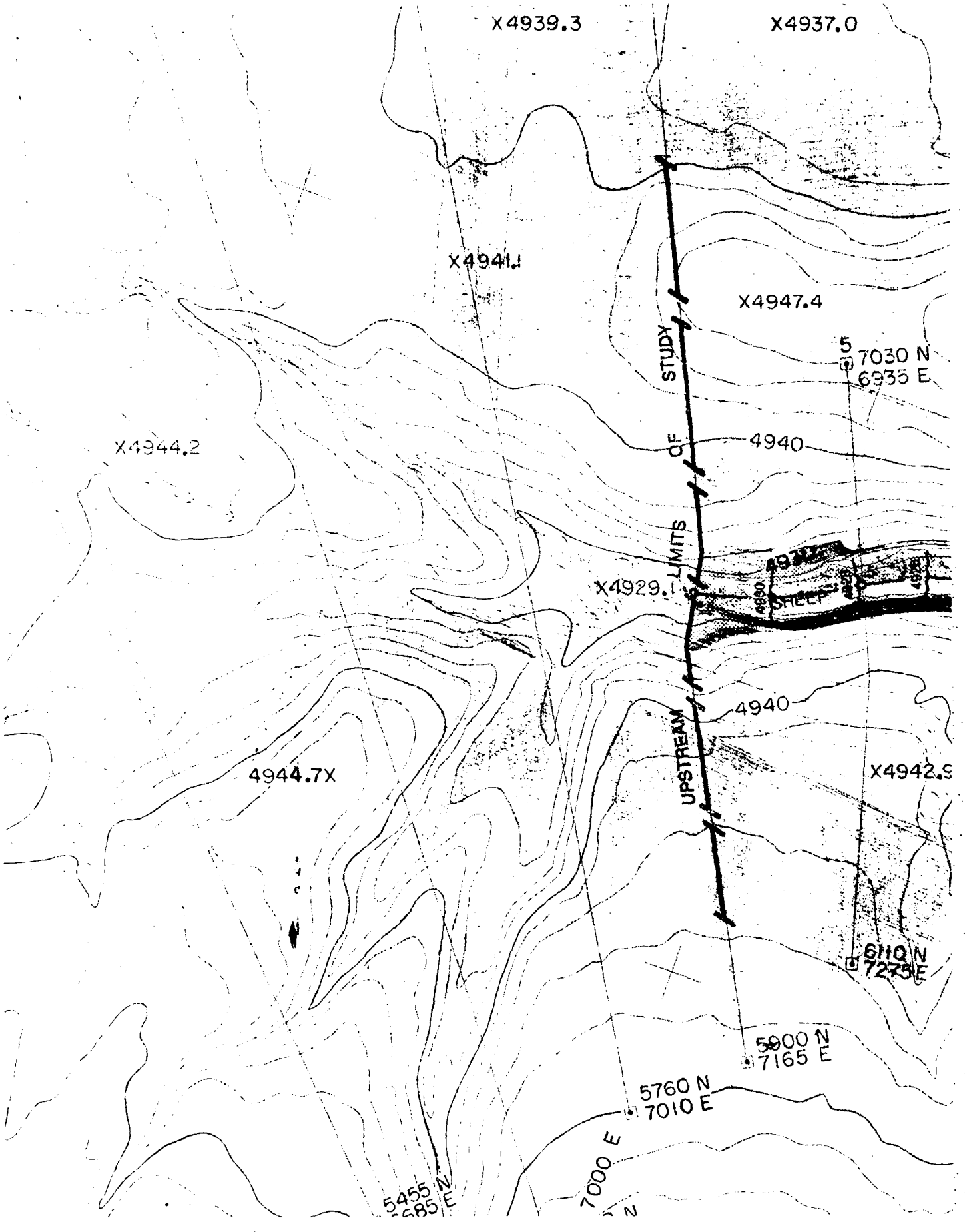
200 0 200 400

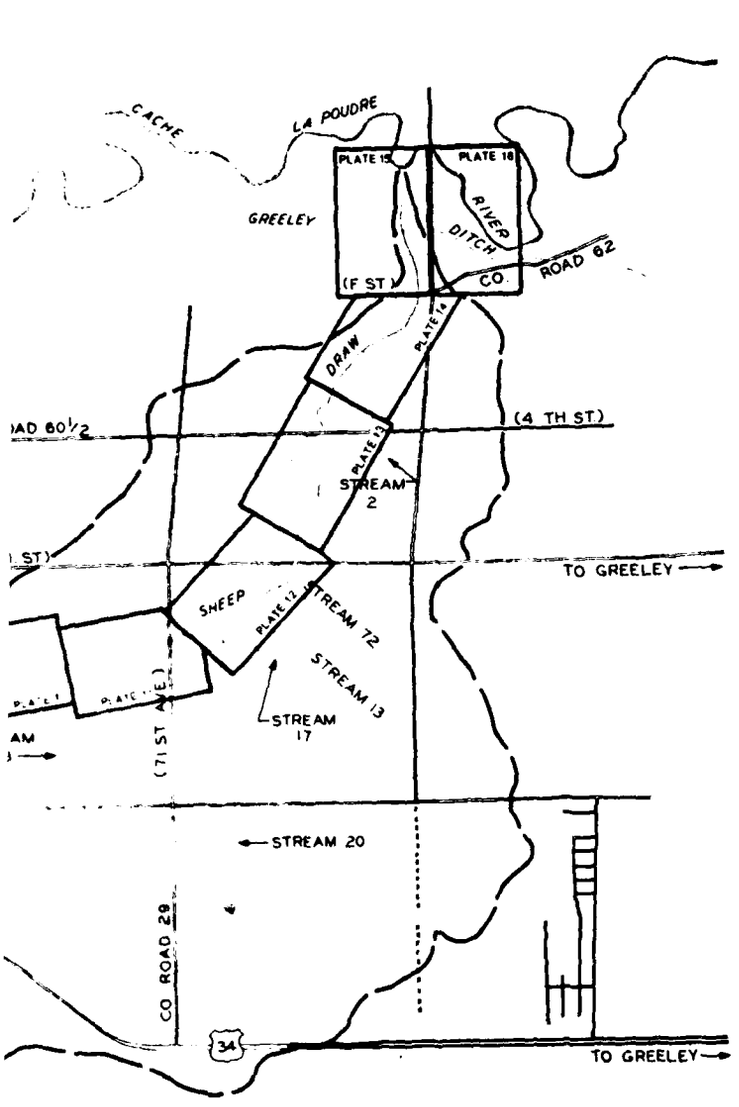
SPECIAL STUDY
CACHE LA POUDRE RIVER BASIN
LARIMER-WELD COUNTIES, COLORADO

SHEEP DRAW
FLOODED AREAS

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCTOBER 1981







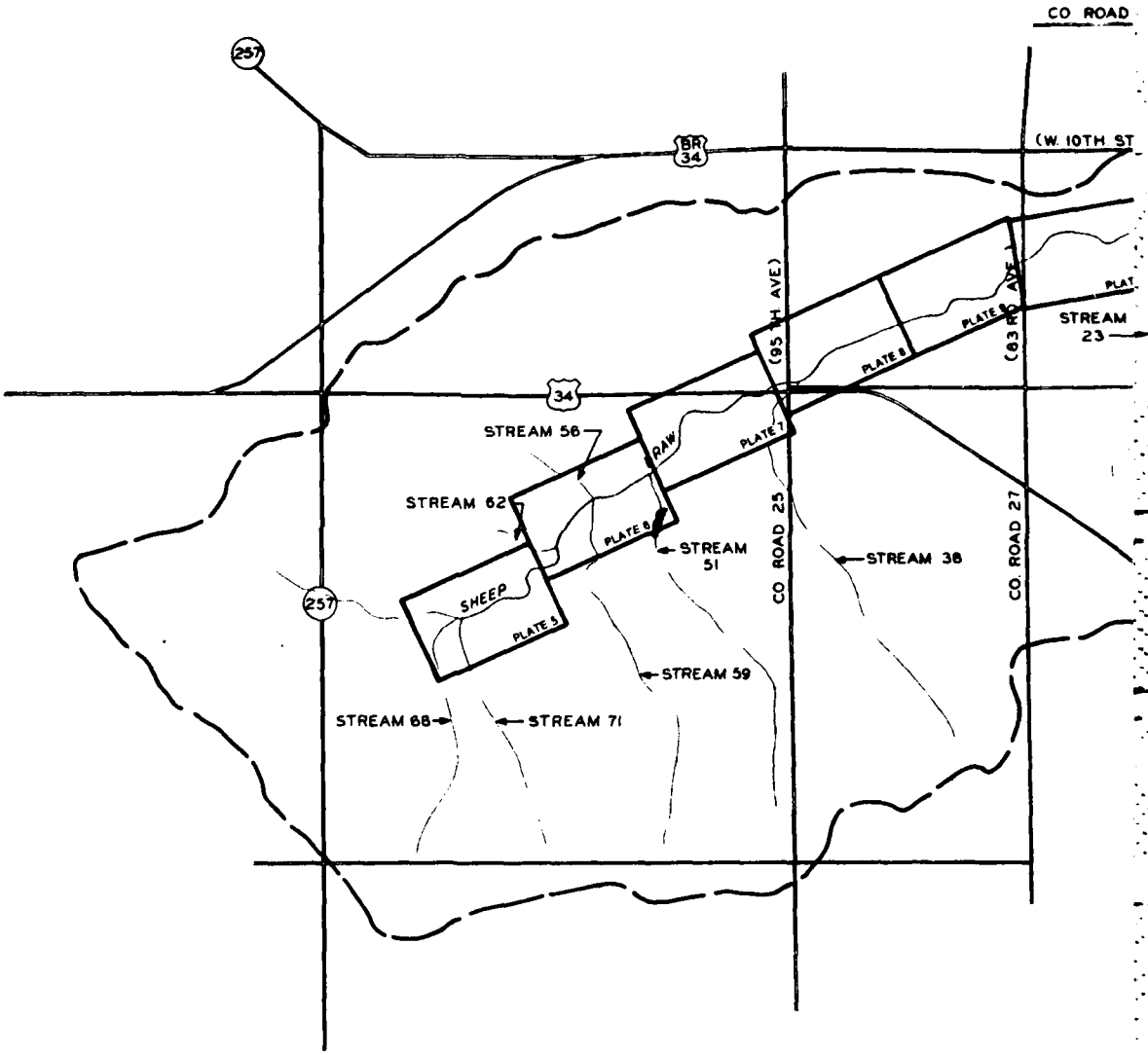
2

SCALE IN FEET
2000 0 2000 4000

SPECIAL STUDY
CACHE LA POUDRE RIVER BASIN
LARIMER-WELD COUNTIES, COLORADO

SHEEP DRAW
PLATE INDEX MAP

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCTOBER 1981



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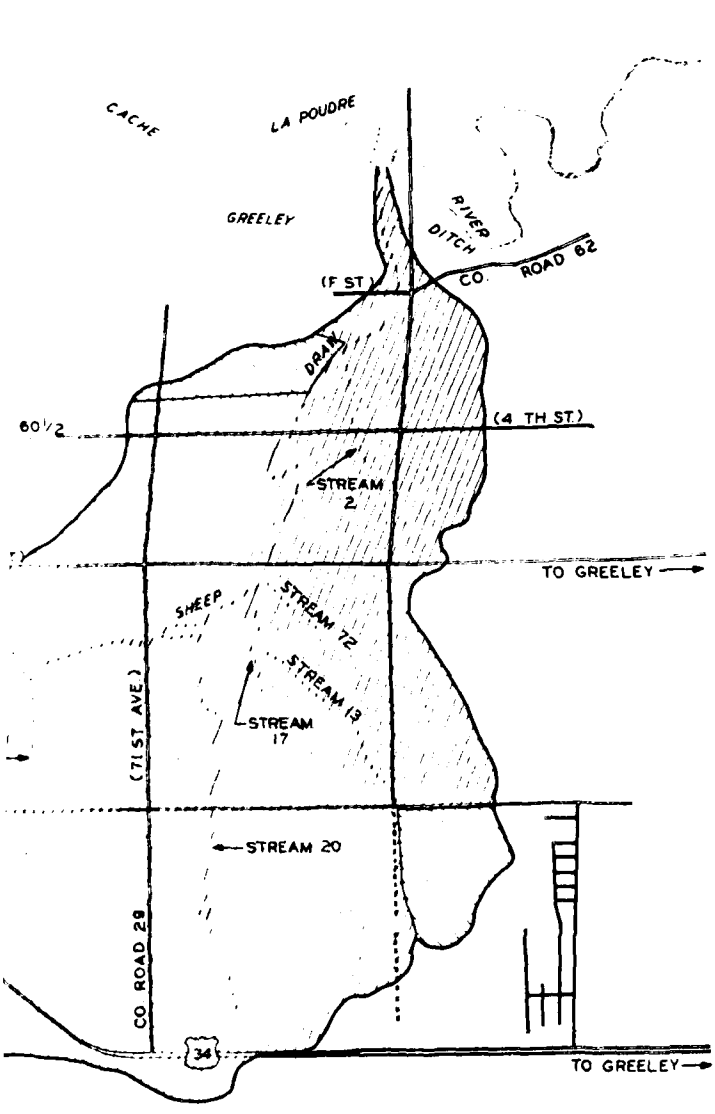

LEGEND

PROJECTED URBANIZATION

ADDITIONAL DEVELOPMENT USED FOR TOTAL URBANIZATION CONDITION

2

SCALE IN FEET
0 2000 4000

SPECIAL STUDY
CACHE LA POUDRE RIVER BASIN
LARIMER-WELD COUNTIES, COLORADO
SHEEP DRAW
FUTURE URBANIZATION

U.S. ARMY ENGINEER DISTRICT, OMAHA
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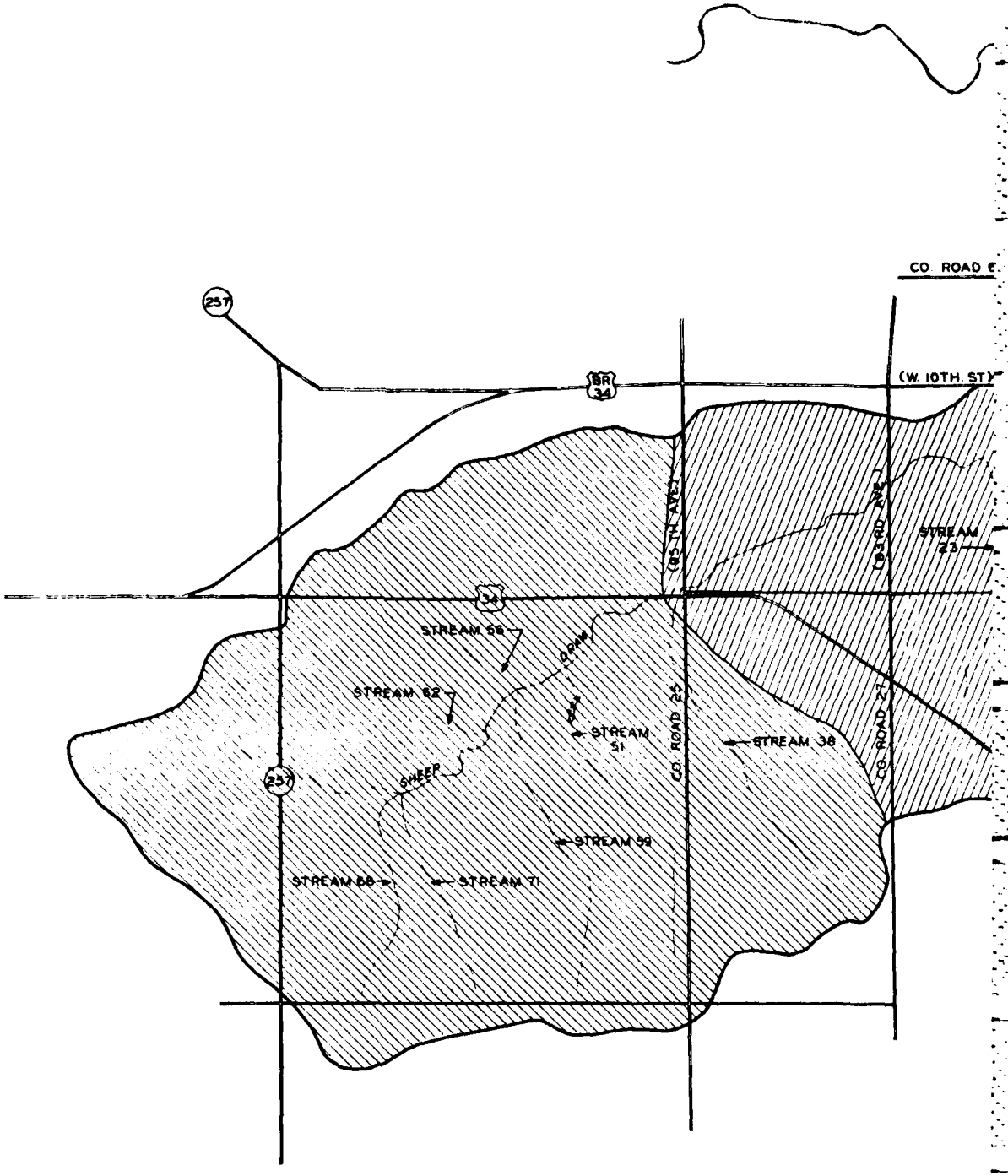

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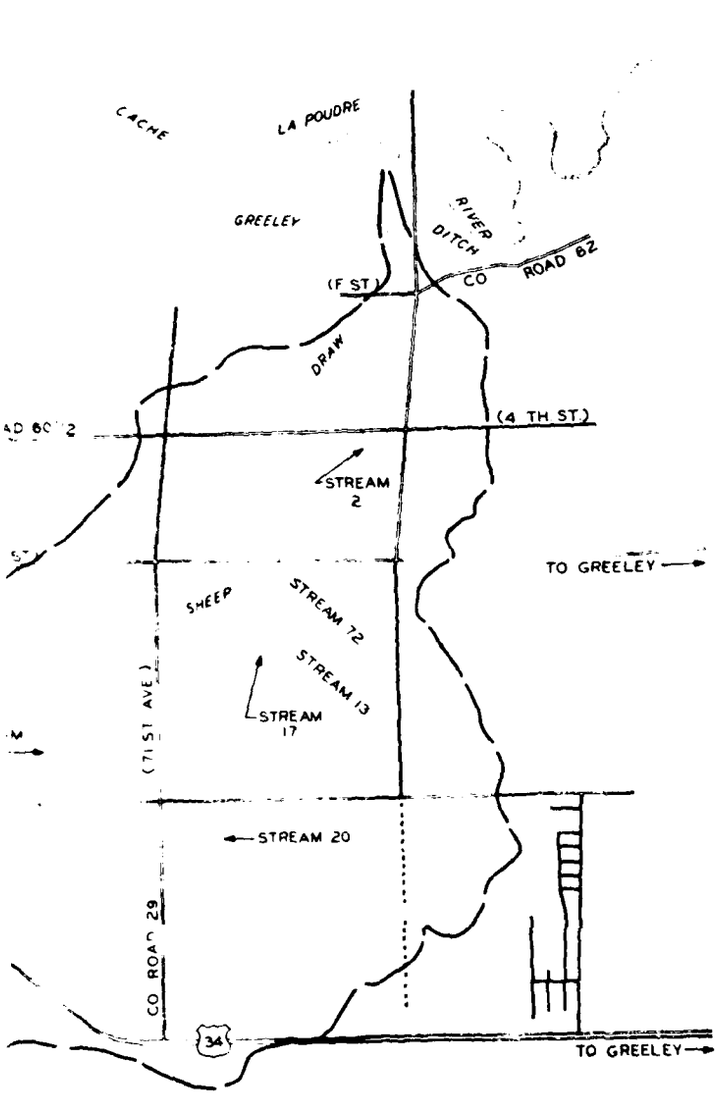
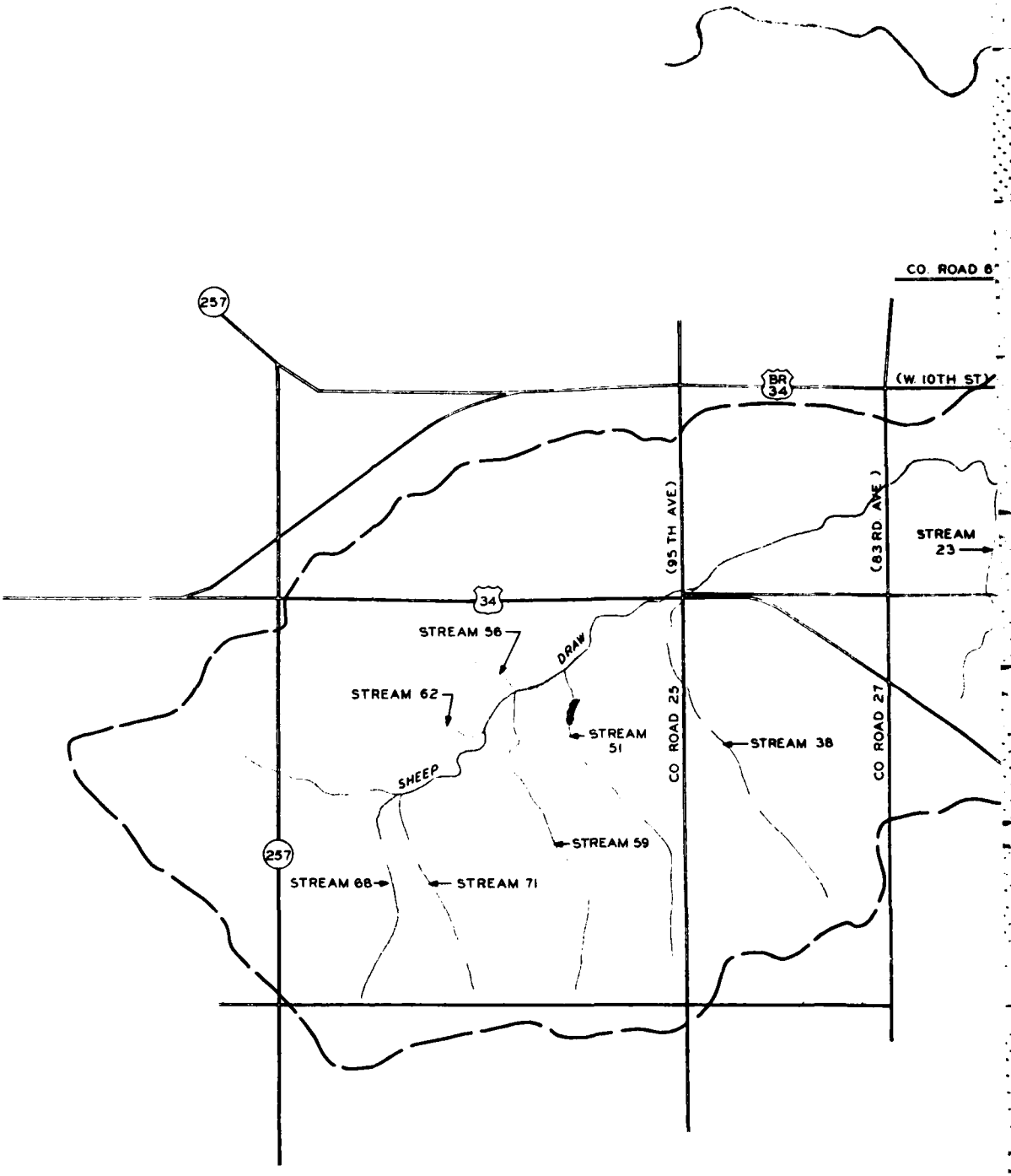


2

SPECIAL STUDY
CACHE LA POUDRE RIVER BASIN
LARIMER-WELD COUNTIES, COLORADO
SHEEP DRAW
BASIN MAP

SCALE IN FEET
2000 0 2000 4000

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCTOBER 1981



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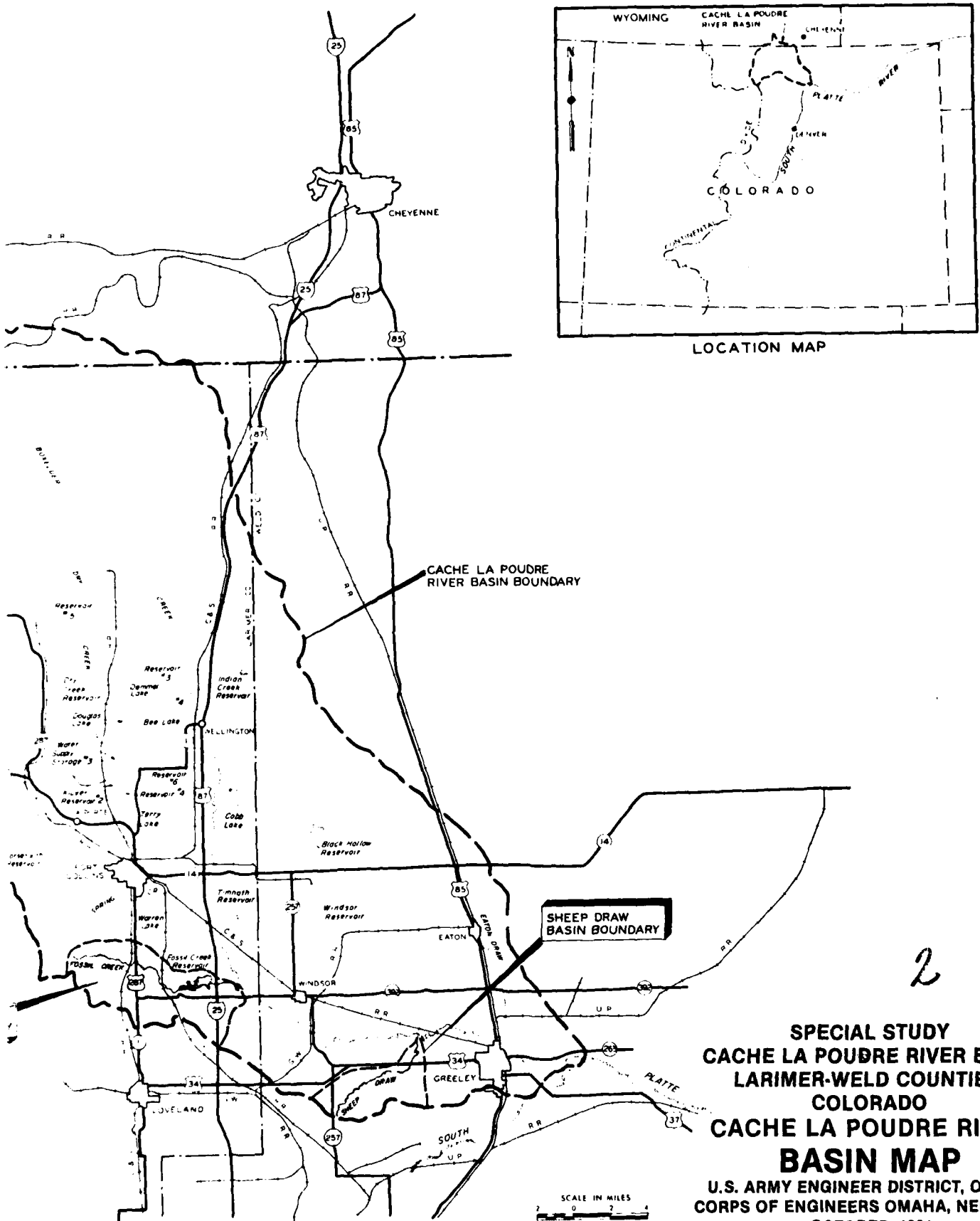
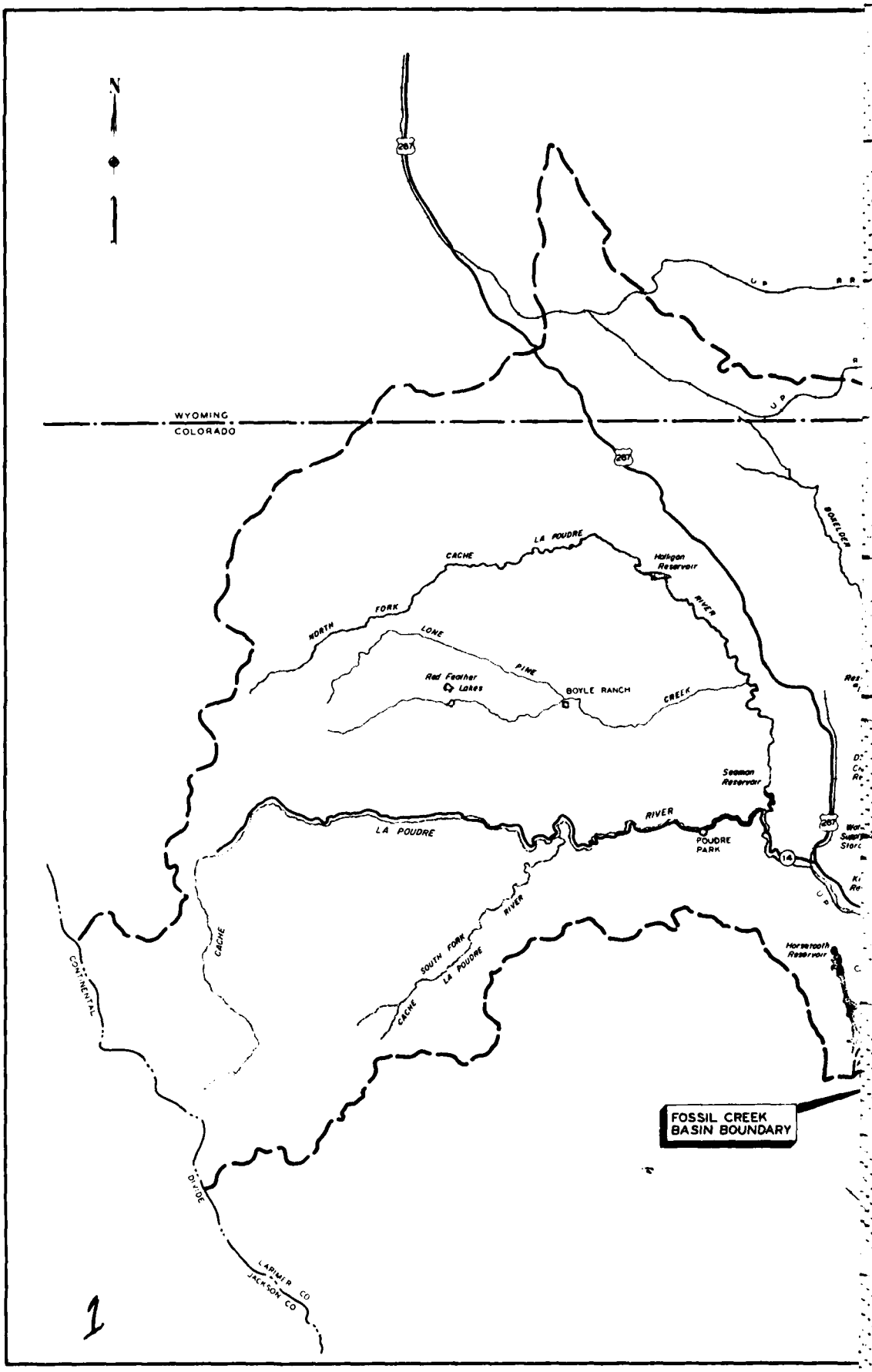


LOCATION MAP

2

SPECIAL STUDY
CACHE LA POUDRE RIVER BASIN
LARIMER-WELD COUNTIES, COLORADO
CACHE LA POUDRE RIVER
BASIN MAP

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCTOBER 1981



water level measured by the gage and comparing it to a stage-discharge relationship which has been established for that stream at the gage location.

Stream Slope

This refers to the slope of a streambed in the downstream direction. This may be expressed in feet per mile or in feet per foot.

Orthophoto Mapping

Mapping which superimposes a contour map on an aerial photograph of the same scale.

Peak Discharge

The maximum instantaneous discharge of a flood at a given location. It usually occurs at or near the time of the flood crest. In the graphical representation of flow versus time, which is known as a flood hydrograph, the peak discharge occurs between the ascension limb and the recession limb.

Photogrammetric

Making topographic measurements by the use of aerial photographs.

Probability

The annual chance of occurrence of specific hydrologic events, such as rainfall, over a specified area or peak discharge at a specified location expressed in percent, e.g., 5 percent representing 1 chance in 20 of the event occurring in any year. The 10-, 50-, 100-, and 500-year floods are floods having a 10-, 2-, 1-, or .2-percent probability, respectively, of occurrence in any year or an average recurrence interval in the order of once in 10, 50, 100, or 500 years, respectively. It may be based on statistical analyses of streamflow records and/or analyses of rainfall and runoff characteristics in the general region of the watershed.

Rainfall Distribution

To more realistically define rainfall and estimate runoff, the total rainfall from an assumed storm of a certain duration may be subdivided into rain falling in shorter time increments. The rainfall may not be the same in all time increments.

Recurrence Interval

(See "Probability")

Reference Number

A numbered point along a stream channel identifying a specific location for correlating the data shown in various forms throughout a report.

Runoff.

The quantity of rainfall which flows over the surface to enter the stream as discharge volume. The difference in quantity between rainfall and runoff represents losses to infiltration, detention storage, and evapo-transpiration.

Stream Gage

A device to indicate the water depth of a stream at a gage site. The discharge at this location can be determined by using the stage or

profile is generally drawn to show surface elevation for the crest of a specific flood but may also be prepared for conditions at a given time or stage.

Flood Reconstitution

In hydrologic studies, this is an attempt to reproduce a historic flood's discharges using a hydrologic model and known historic rainfall and watershed data. In hydraulic studies, this is an attempt to recreate a past flood's water levels using recorded discharges.

Frequency

(See "Probability")

Future Conditions

In this report, this refers to the potential future extent of urban development in the Sheep Draw basin. Also under this condition, the irrigation canals and the small irrigation dams were assumed to be removed. The roadways were assumed to remai. in place.

Hydraulic Analysis

This refers to the determination of stream water surface elevations using discharges of specified probabilities, cross sections, channel and overbank roughness, and the geometry of obstructions.

Hydrologic Analysis

This refers to the determination of discharge-probability relationships at various locations.

Imperviousness

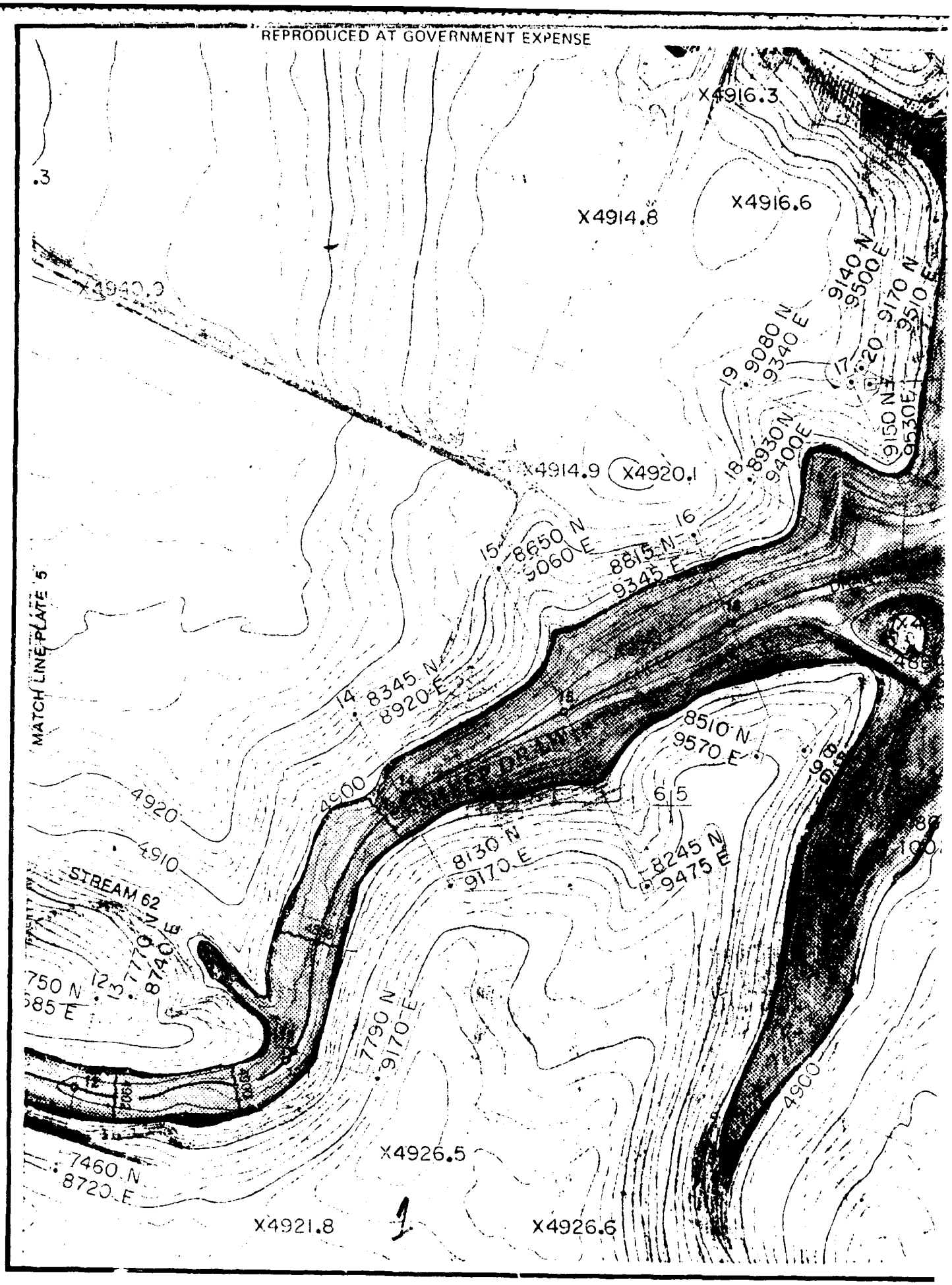
The degree to which an area will shed water and not allow rainfall to penetrate. For example, paved areas are essentially impervious, while sandy areas are very pervious.

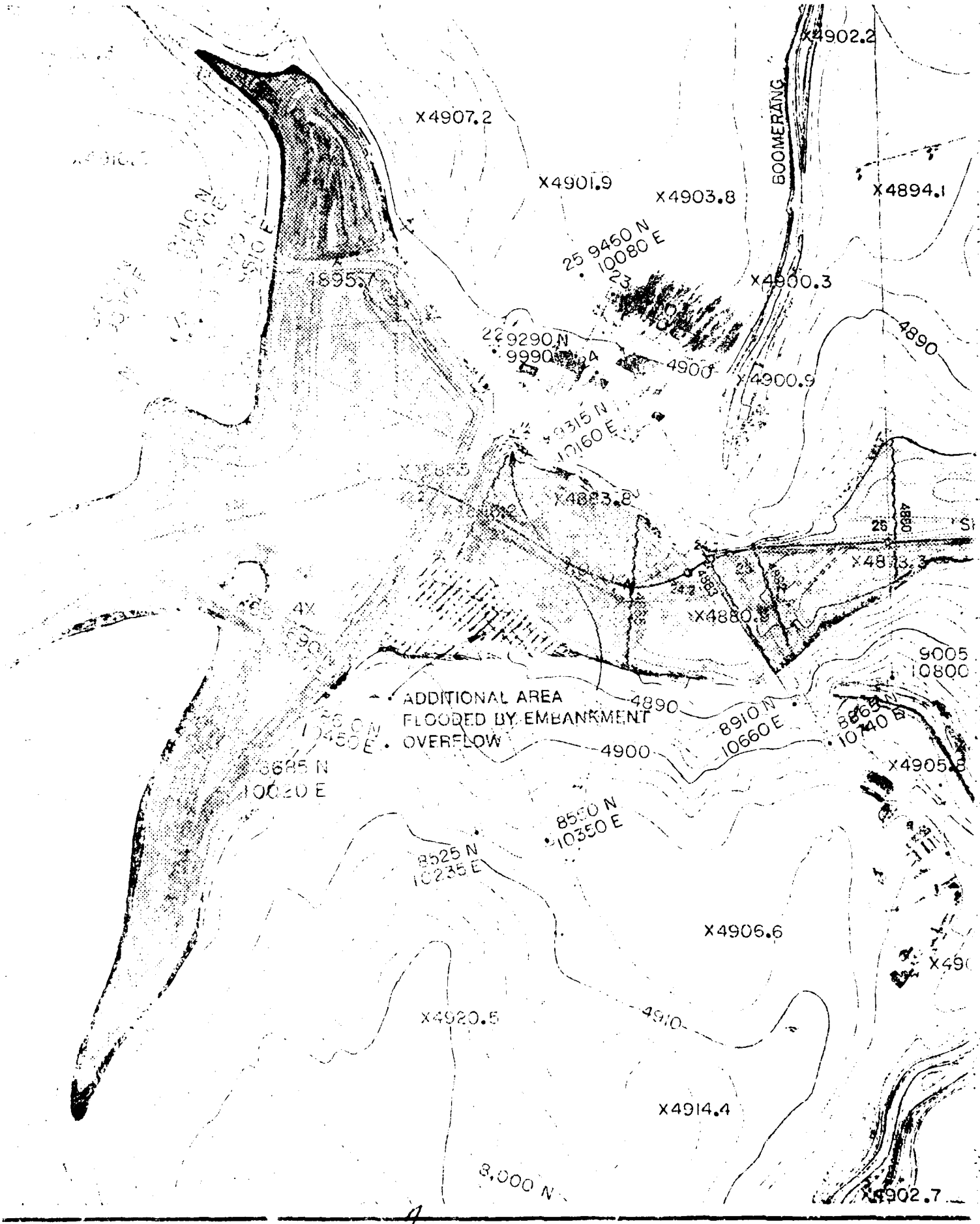
Infiltration

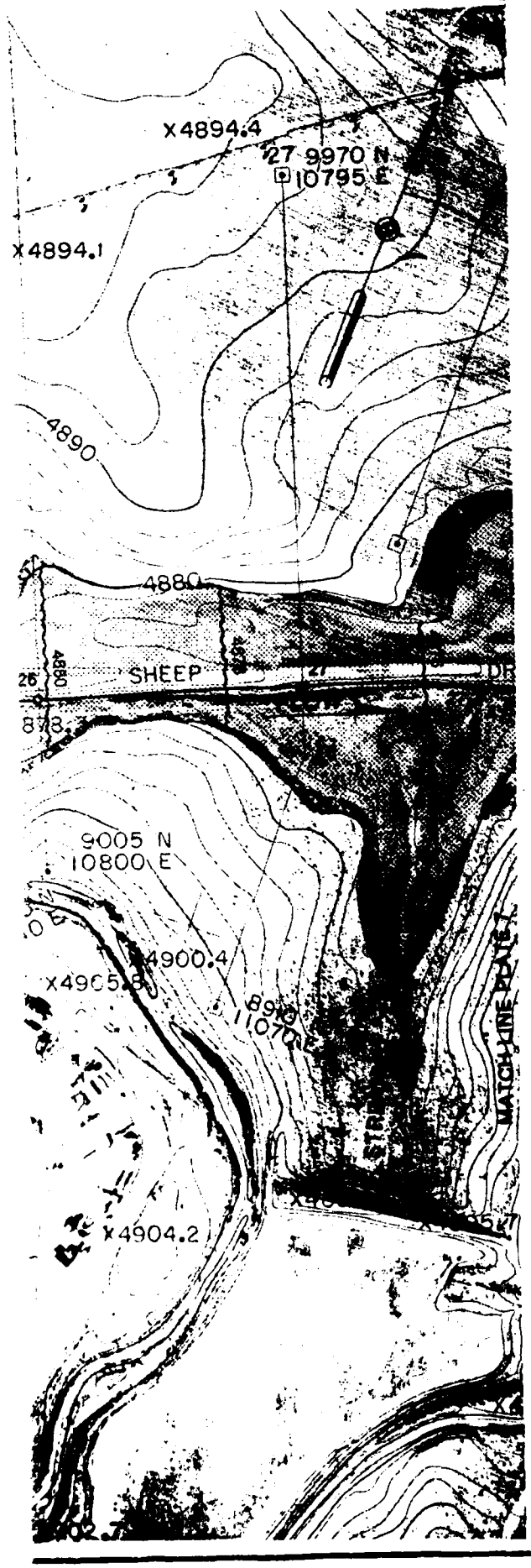
Precipitation soaking into the ground. For example, a sandy soil may absorb a great deal of rainfall without leaving an excess for surface runoff. This may be expressed as the total proportion of rainfall absorbed or as an infiltration rate in inches per hour (see "Runoff").

Manning's "n"

A measure of the resistance to flow offered by a channel or flood plain. A low value indicates less resistance to the passage of water. For example, clean, straight, concrete or earth channels might have "n" values of 0.013 and 0.025, respectively. A shallow, weedy channel might have an "n" value in excess of 0.100. Factors other than roughness influence "n" values. Some other factors include vegetation, channel bends, sediment, and stream slope.







LEGEND:

500 YEAR FLOOD
100 YEAR FLOOD

4846 — 100 Year Flood Elevation Line in Feet M.S.L.

27 — Reference Point — Also locations of surveyed cross sections

NOTES:

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SCALE IN FEET

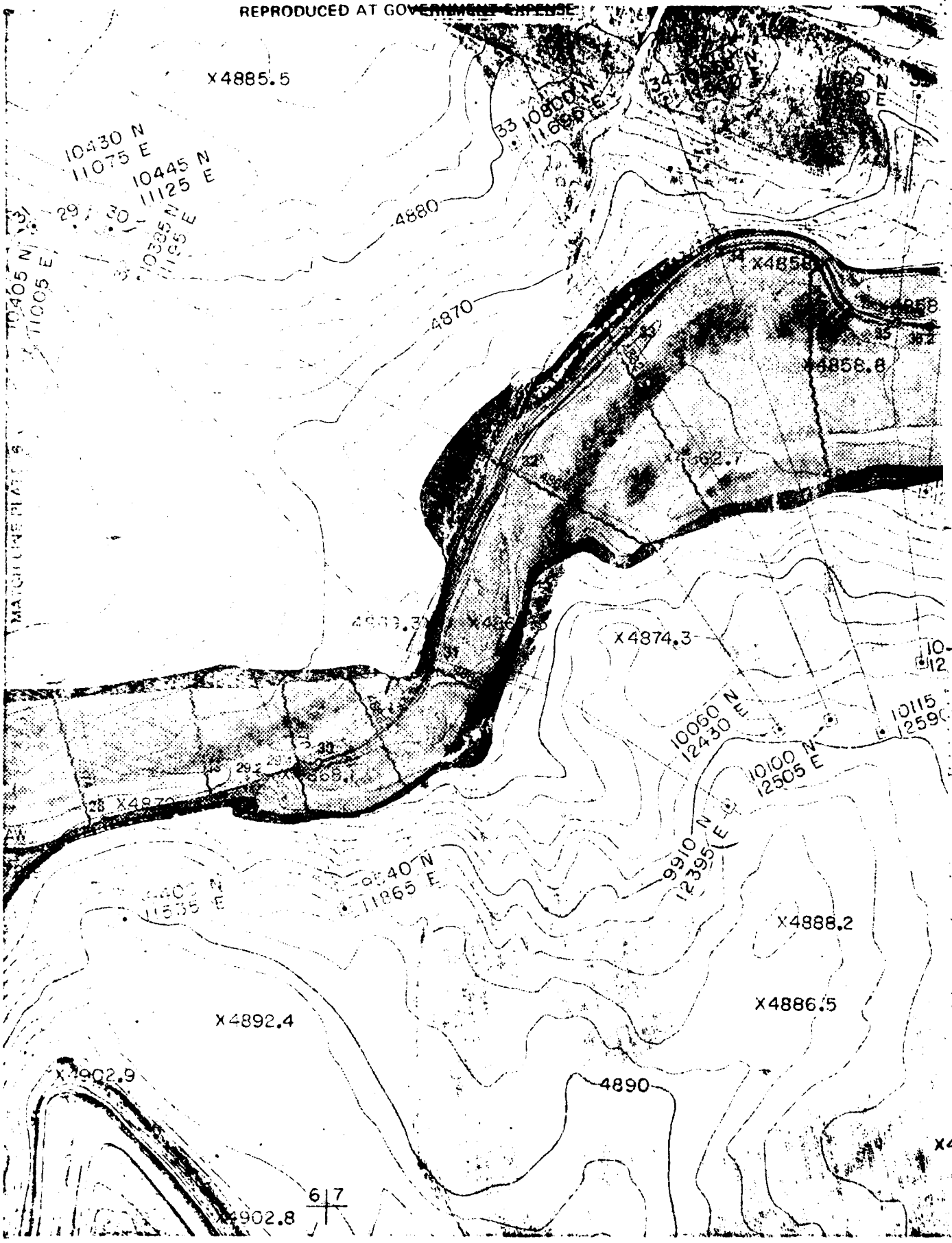
200 0 200 400

SPECIAL STUDY
CACHE LA POUDRE RIVER BASIN
LARIMER-WELD COUNTIES, COLORADO

SHEEP DRAW
FLOODED AREAS

3

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCTOBER 1981



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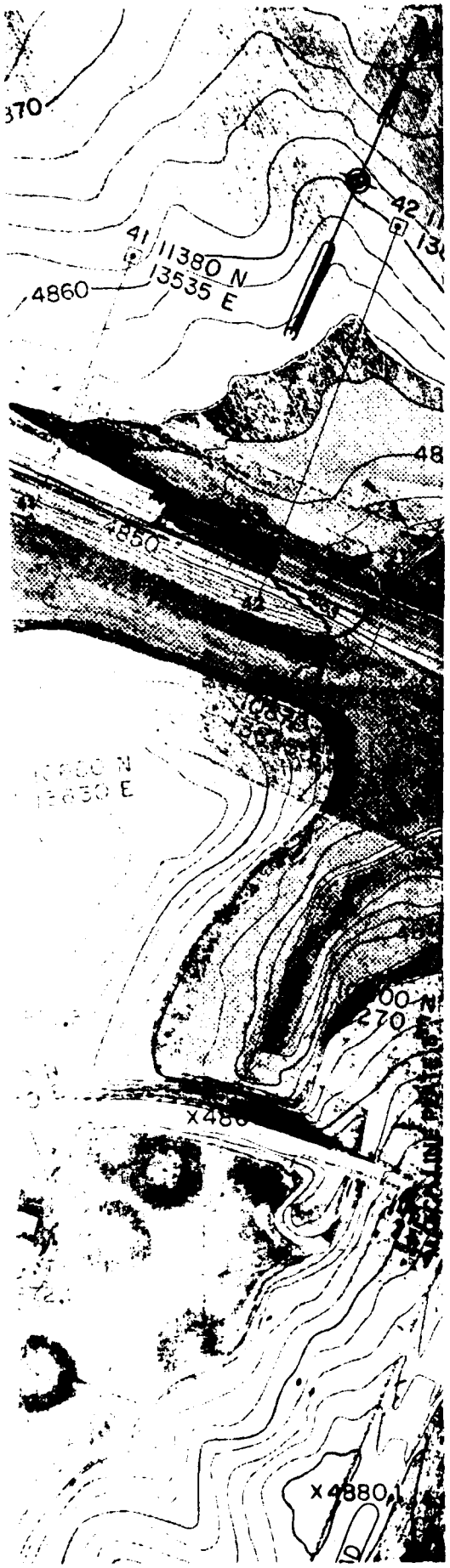

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SPECIAL STUDY
CACHE LA POUDRE RIVER BASIN
LARIMER-WELD COUNTIES, COLORADO

SHEEP DRAW
FLOODED AREAS

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCTOBER 1981

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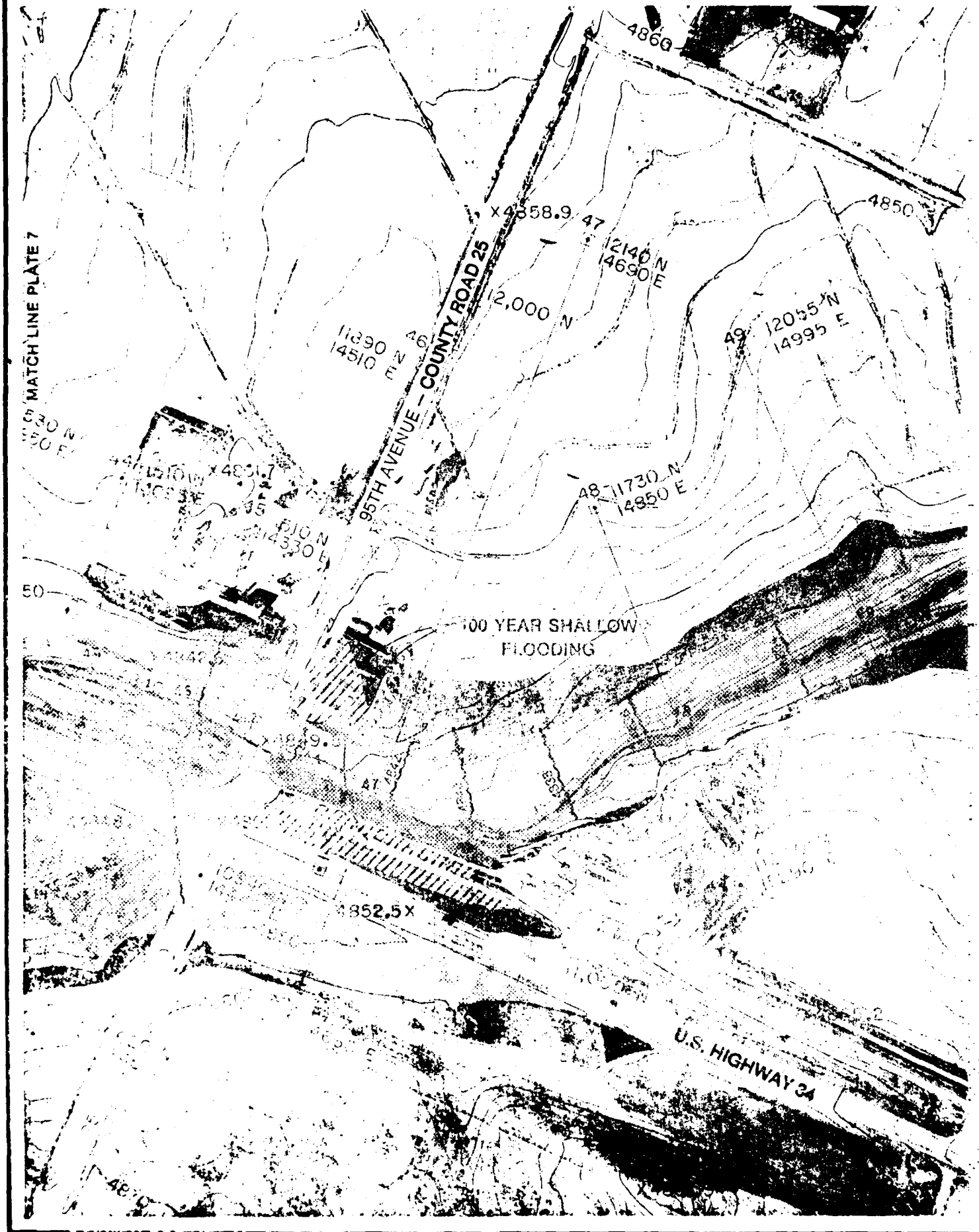

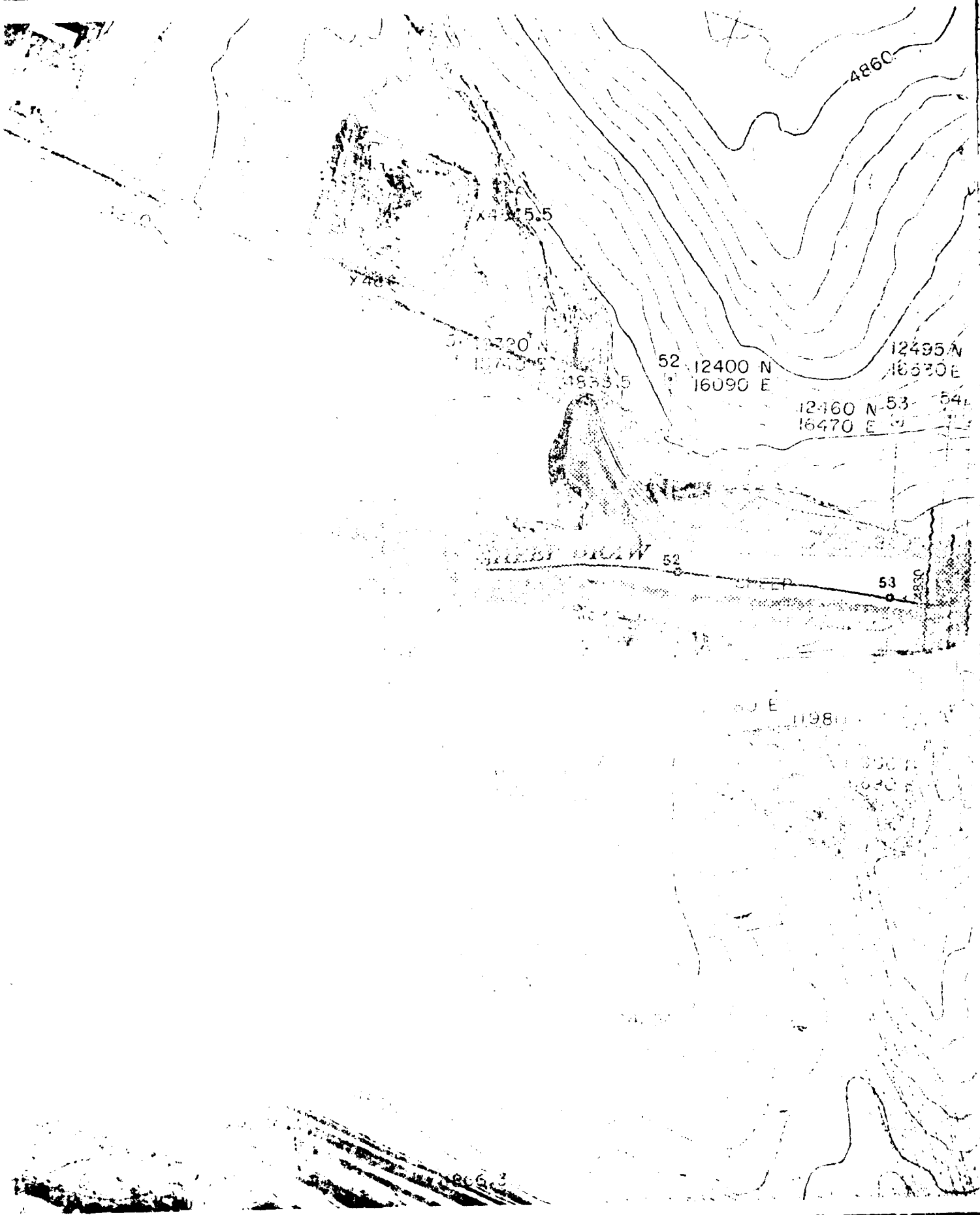

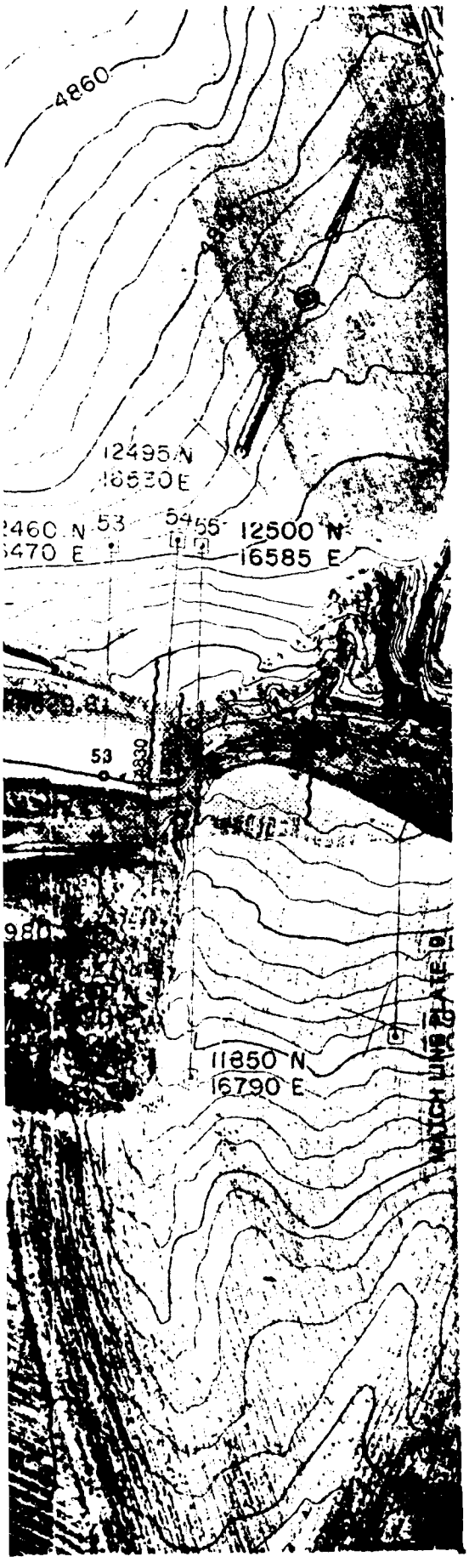

LEGEND:

500 YEAR FLOOD
100 YEAR FLOOD

4846 — 100 Year Flood Elevation Line in Feet M.S.L.

27 — Reference Point — Also locations of surveyed cross sections

NOTES:

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2. For Profile, see Plates 17-22.
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4. Flooded areas represent existing conditions.

SCALE IN FEET

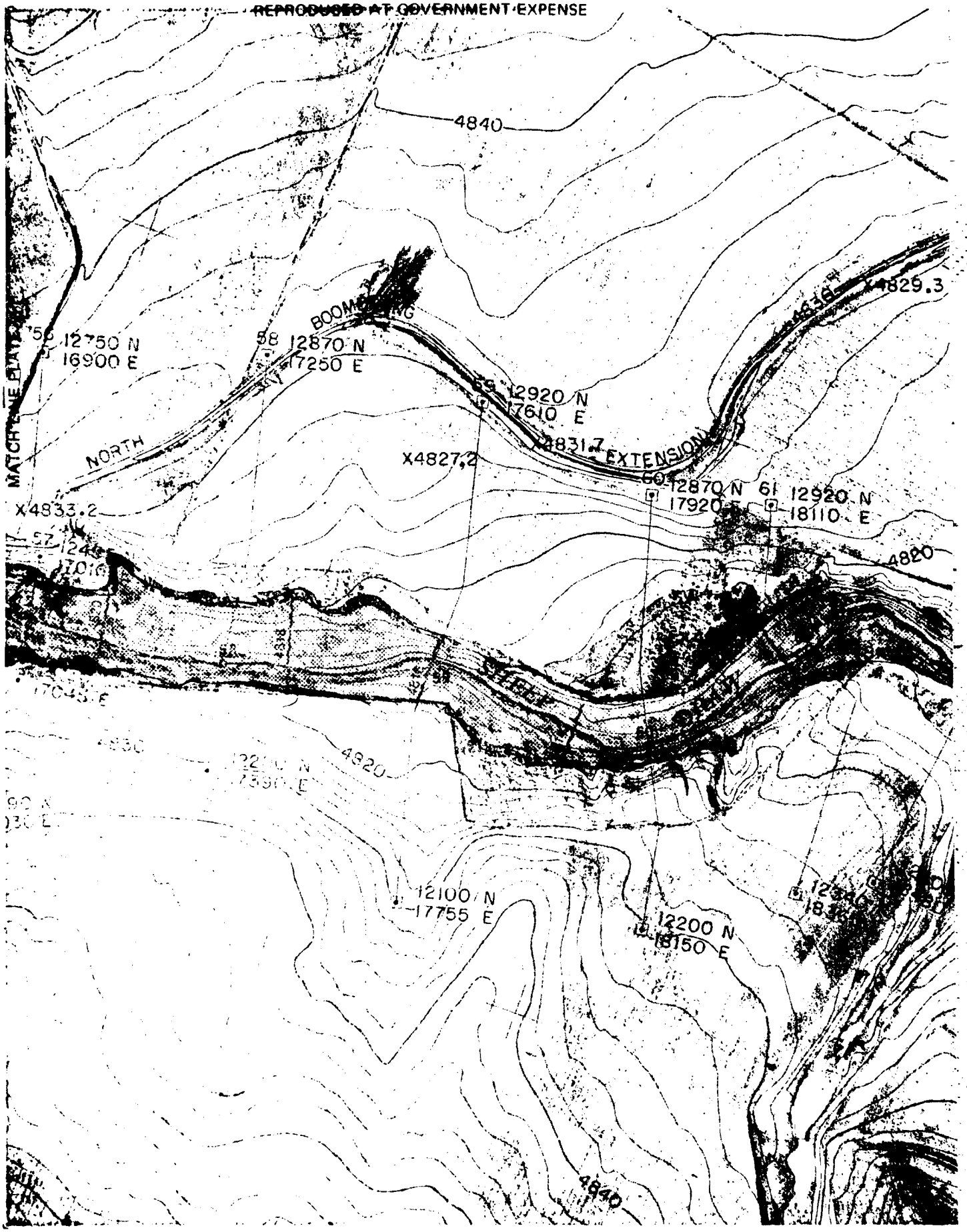
200 0 200 400

SPECIAL STUDY
CACHE LA POUDRE RIVER BASIN
LARIMER-WELD COUNTIES, COLORADO

SHEEP DRAW
FLOODED AREAS

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCTOBER 1981

3



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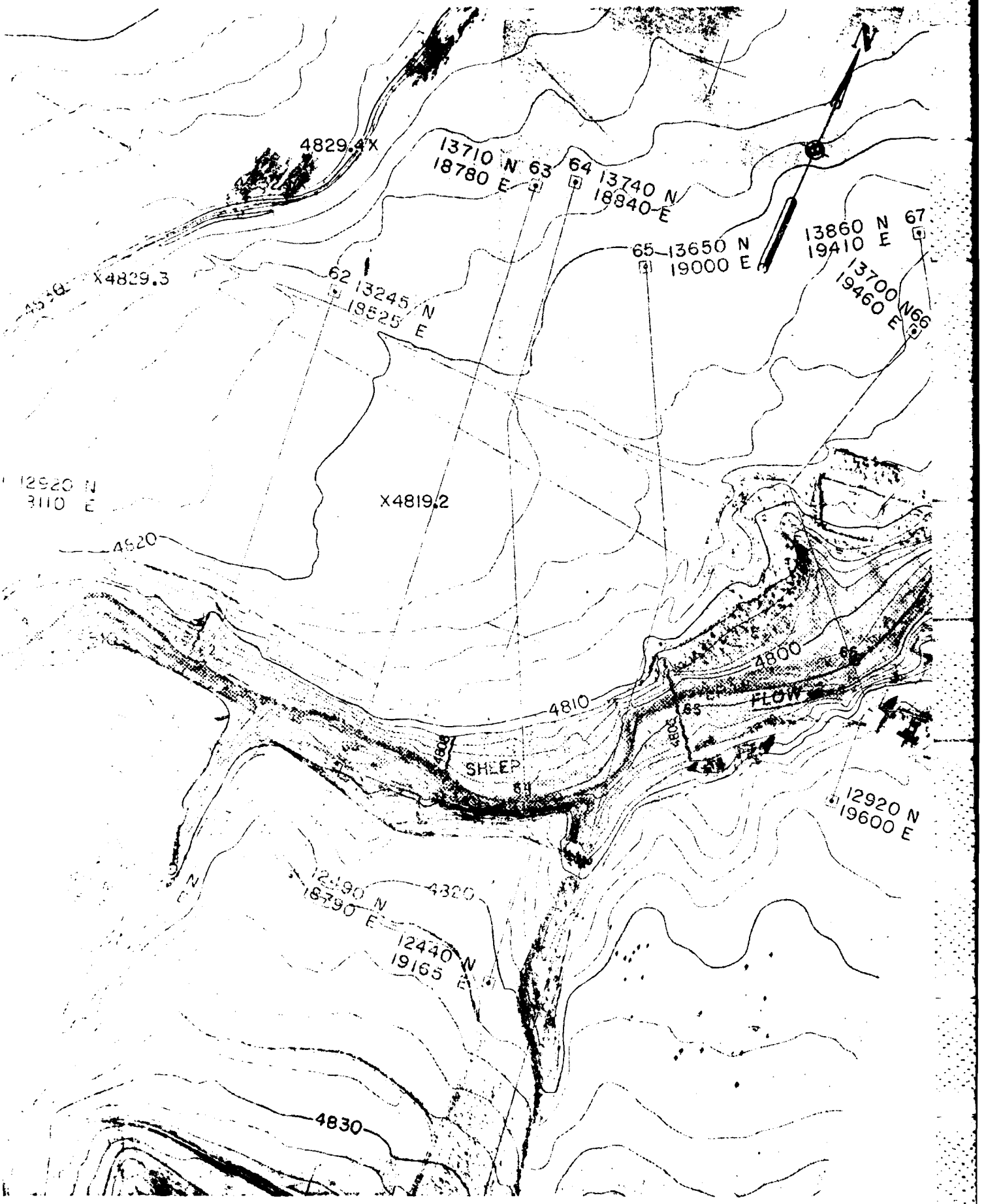

LEGEND:

500 YEAR FLOOD
100 YEAR FLOOD

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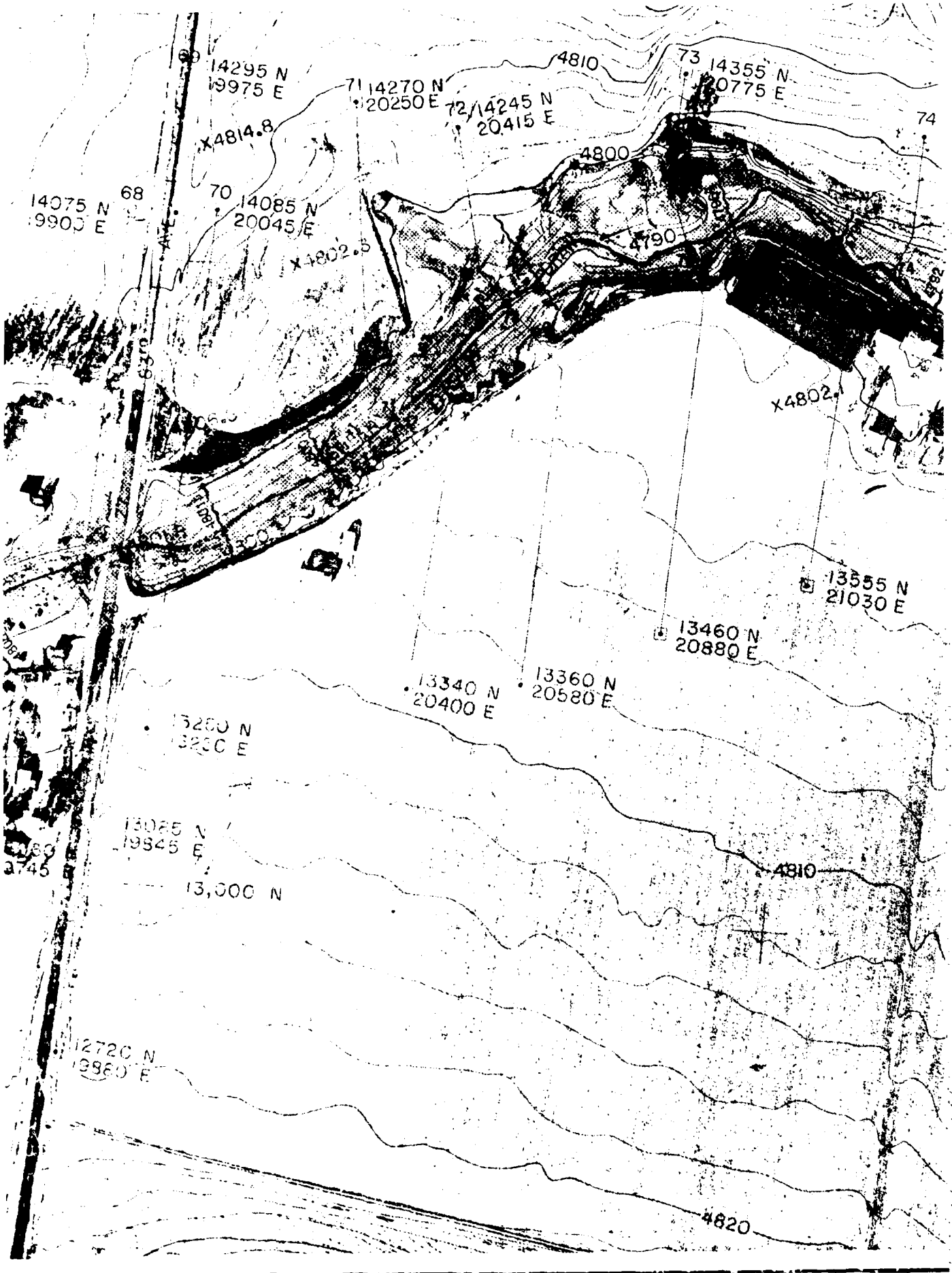
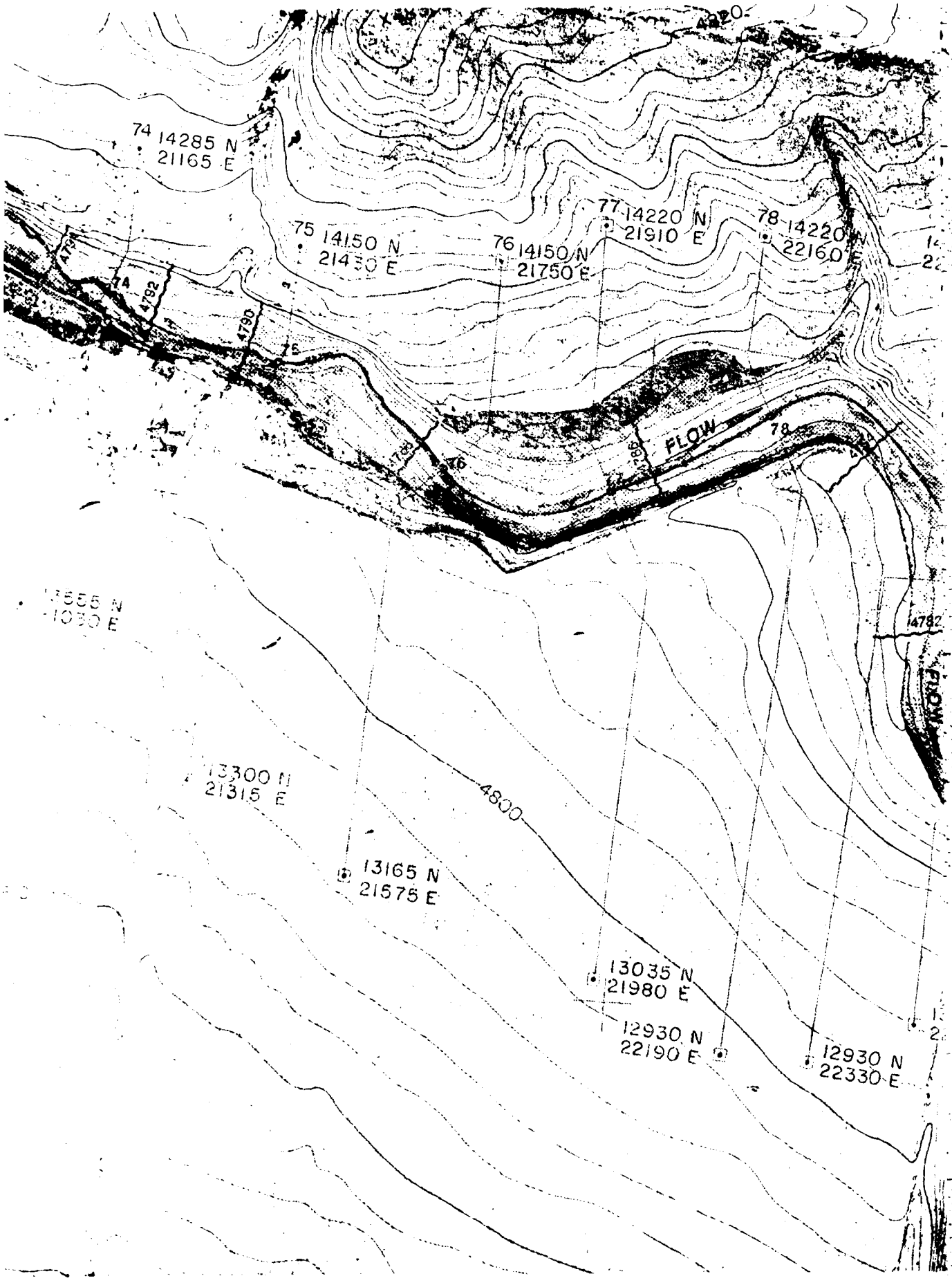
CACHE LA POUDRE RIVER BASIN
LARIMER-WELD COUNTIES, COLORADO

SHEEP DRAW
FLOODED AREAS

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCTOBER 1981

3





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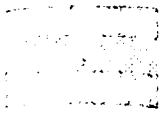

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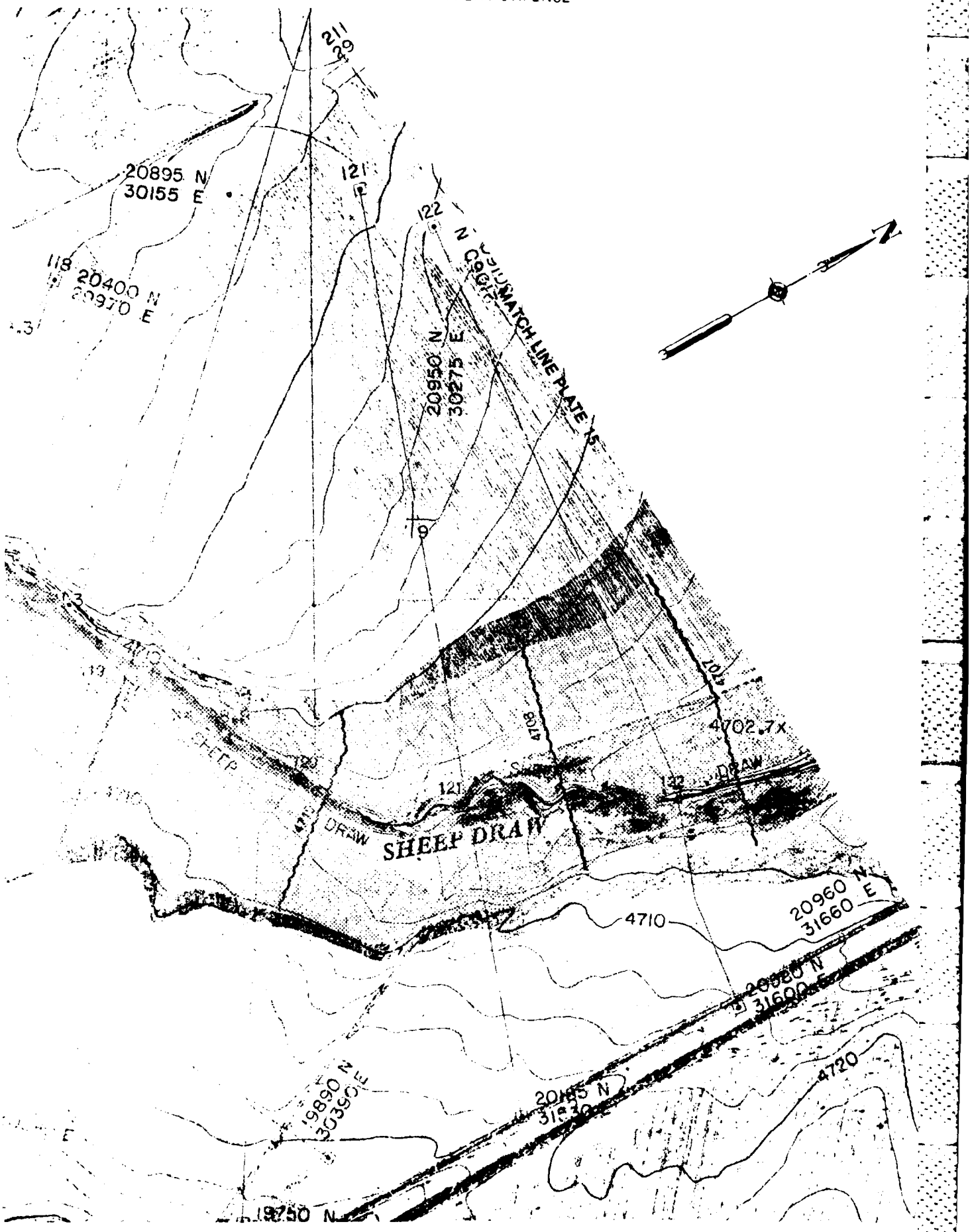
CACHE LA POUDRE RIVER BASIN
LARIMER-WELD COUNTIES, COLORADO

SHEEP DRAW
FLOODED AREAS

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCTOBER 1981



LEGEND:

500 YEAR FLOOD
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CACHE LA POUDRE RIVER BASIN
LARIMER-WELD COUNTIES, COLORADO

SHEEP DRAW
FLOODED AREAS

U.S. ARMY ENGINEER DISTRICT, OMAHA
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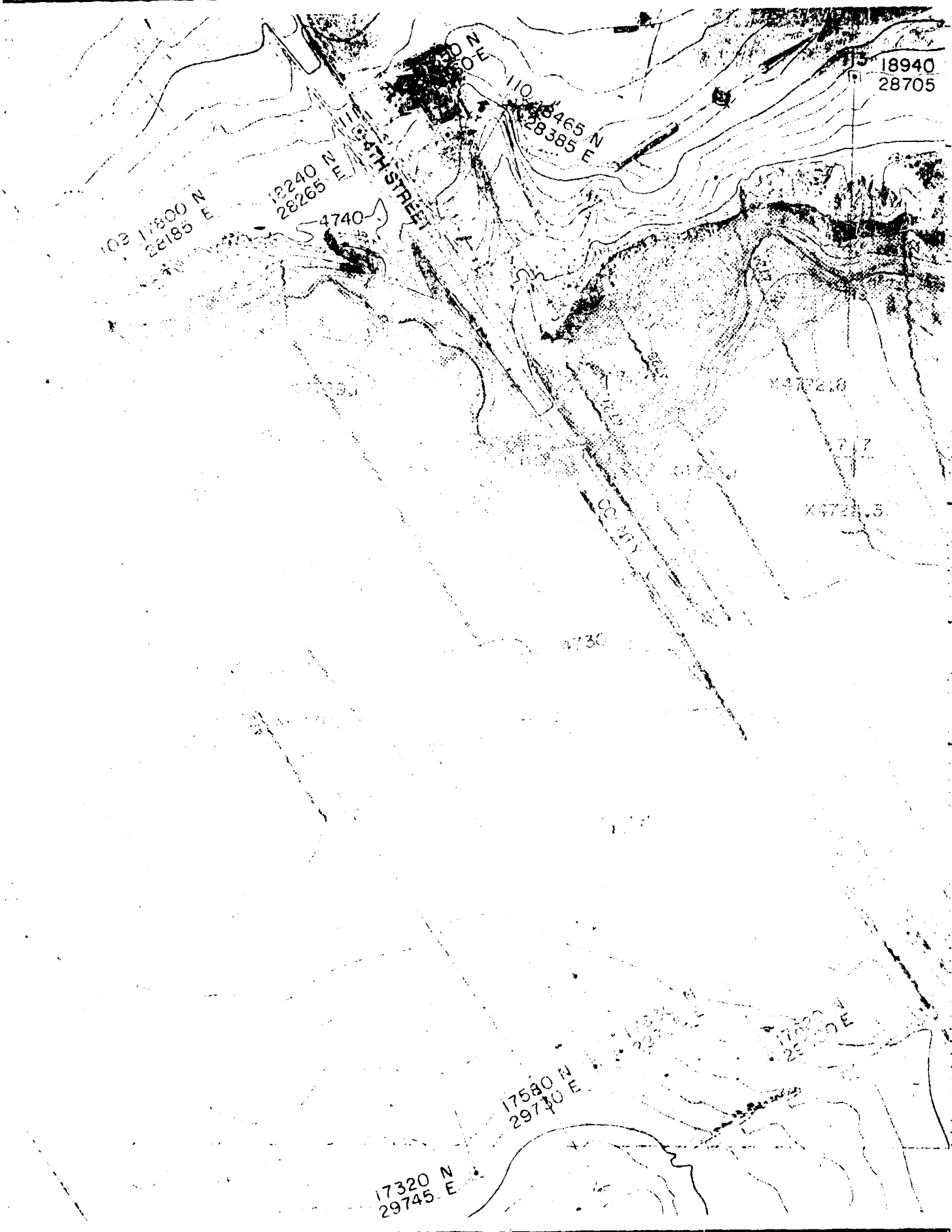
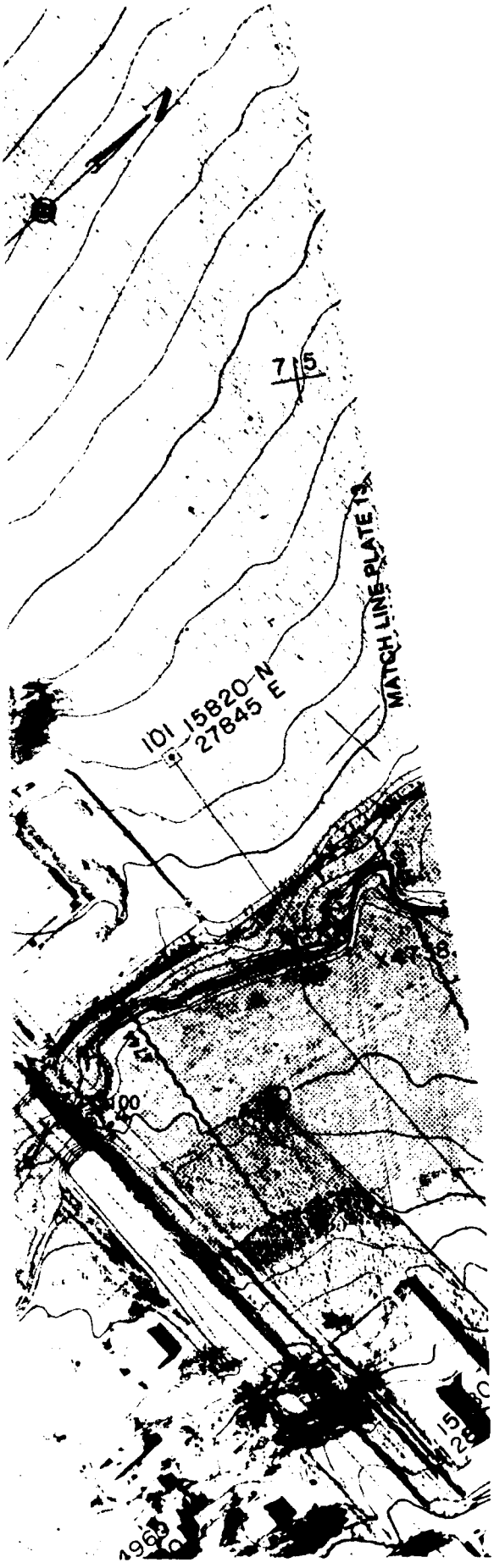
OCTOBER 1981





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100 YEAR FLOOD

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LARIMER-WELD COUNTIES, COLORADO

SHEEP DRAW
FLOODED AREAS

U.S. ARMY ENGINEER DISTRICT, OMAHA
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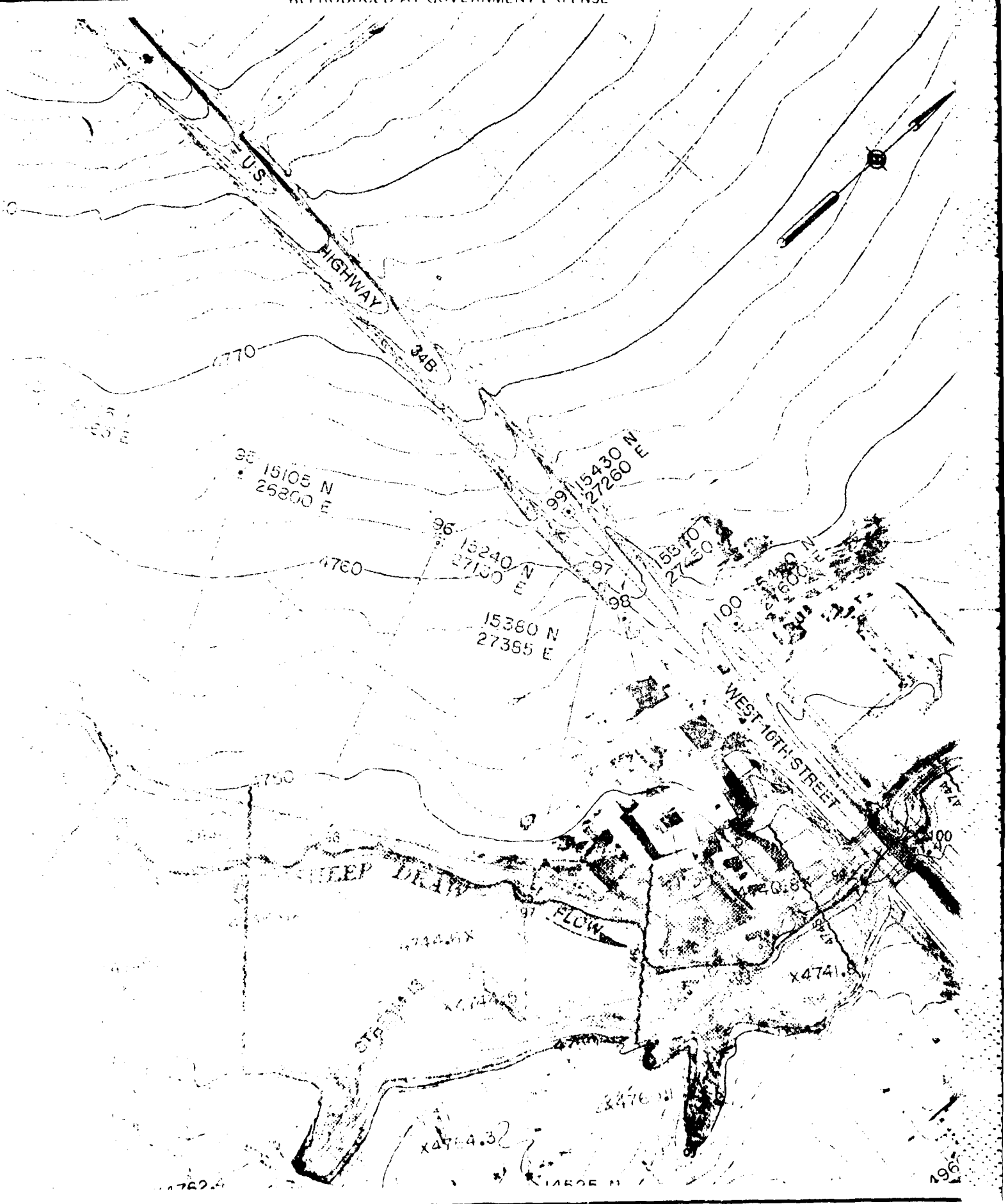
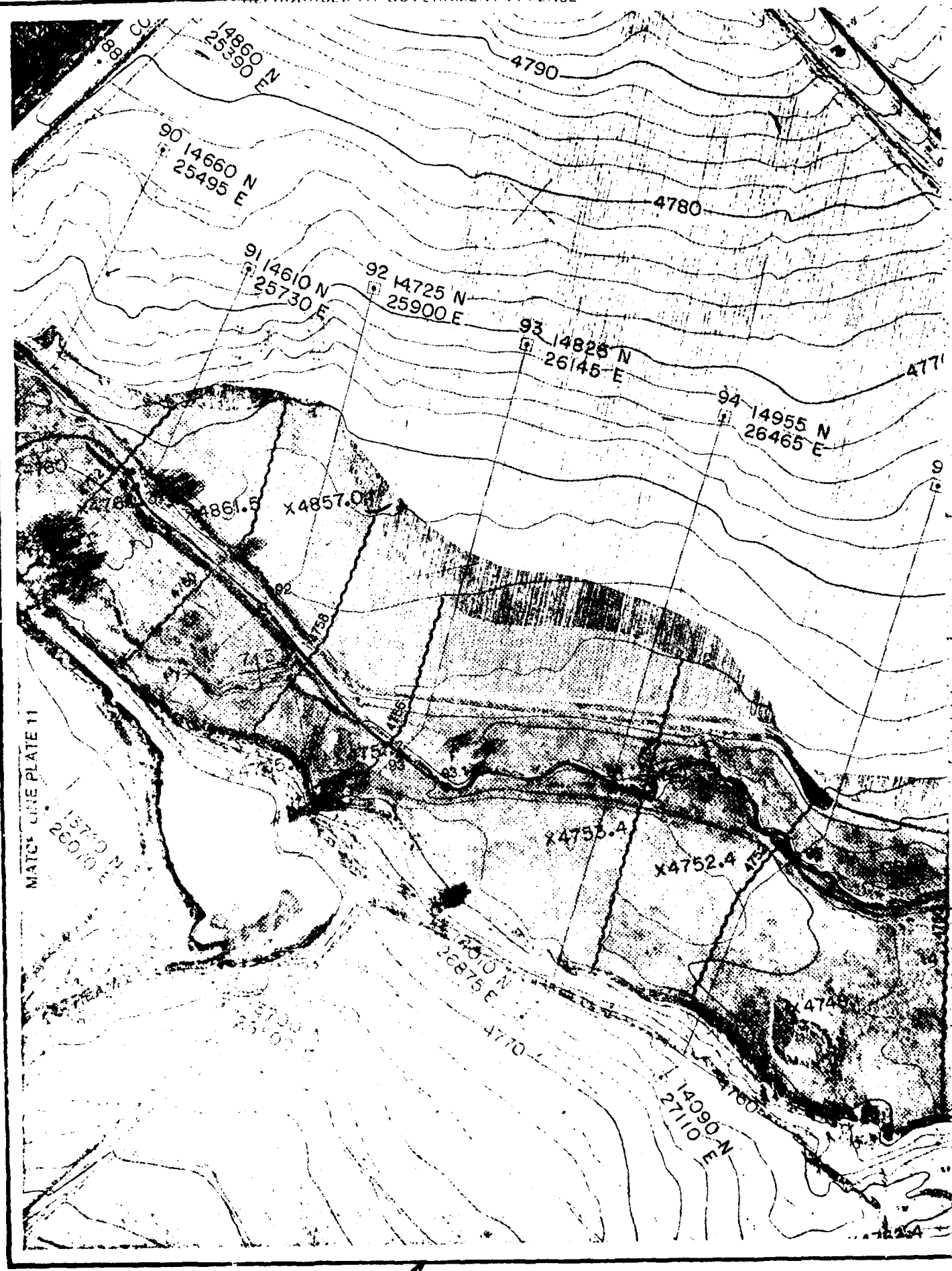
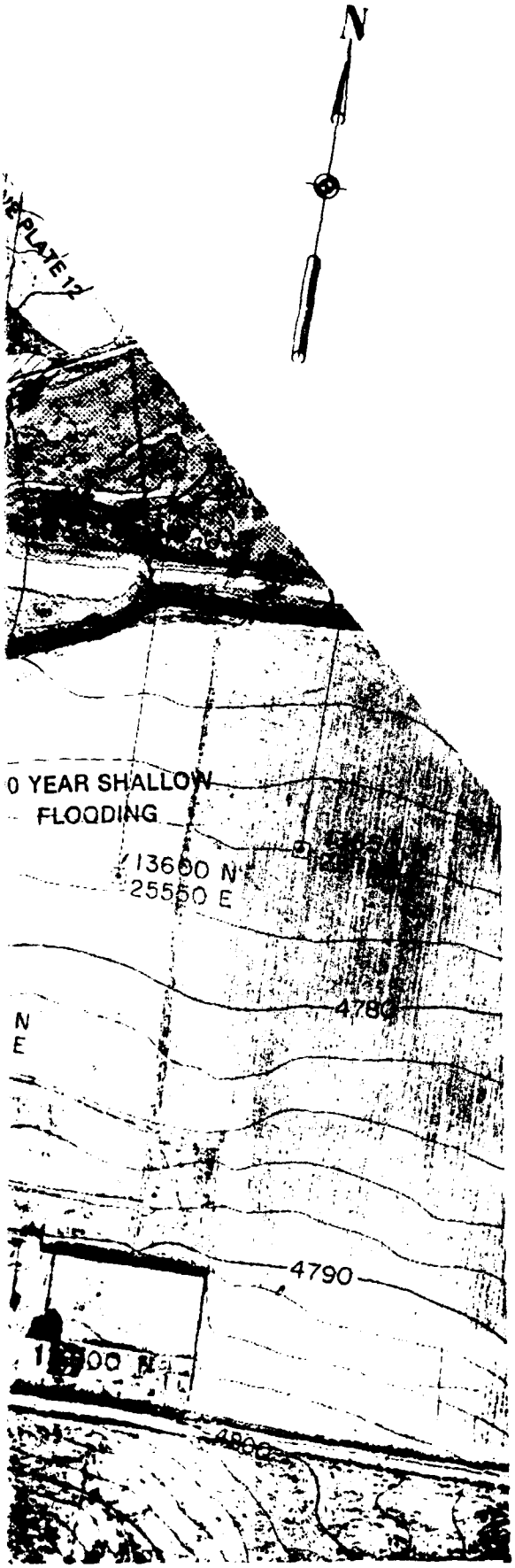
OCTOBER 1981







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100 YEAR FLOOD

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SPECIAL STUDY
CACHE LA POUDRE RIVER BASIN
LARIMER-WELD COUNTIES, COLORADO

SHEEP DRAW
FLOODED AREAS

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCTOBER 1981

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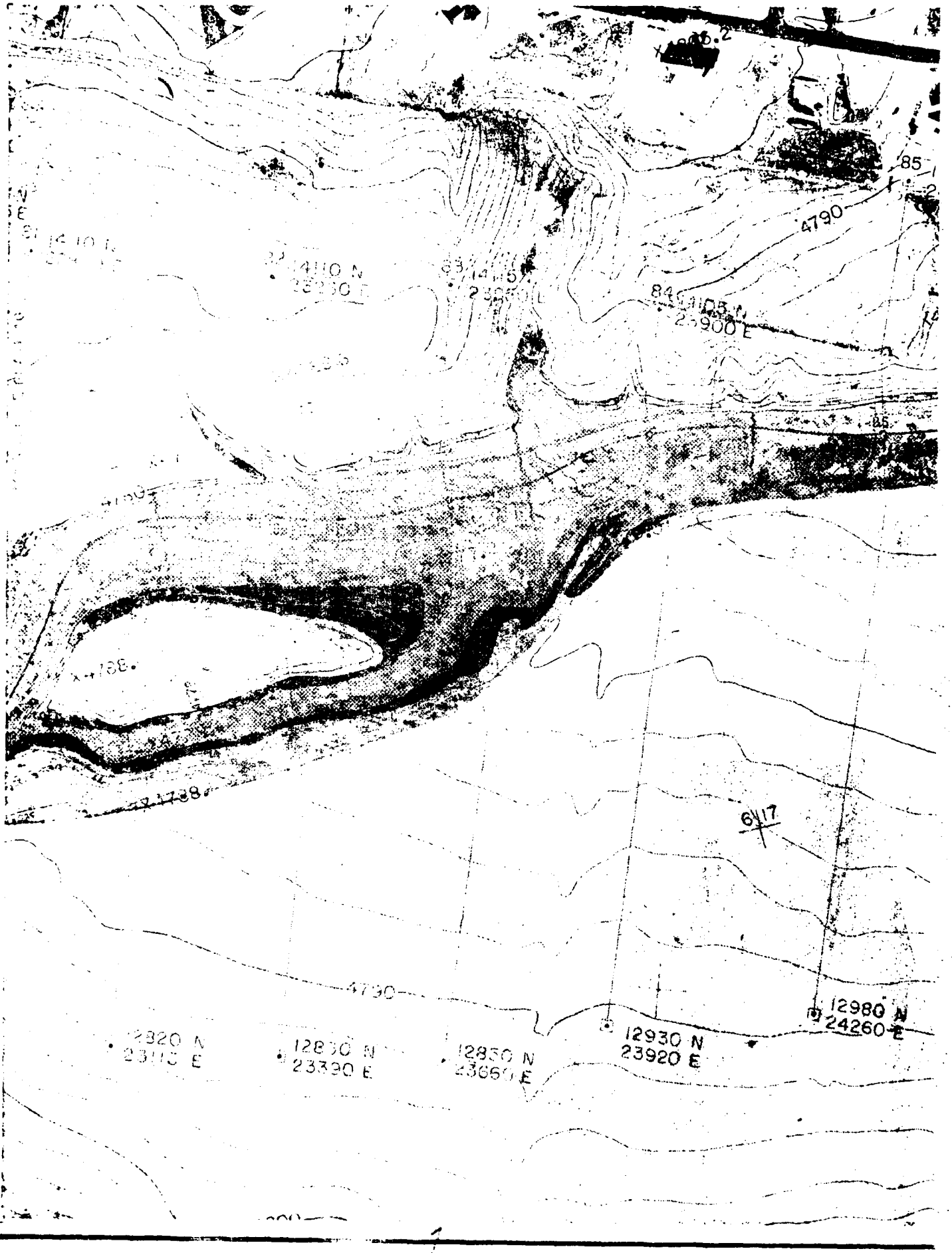

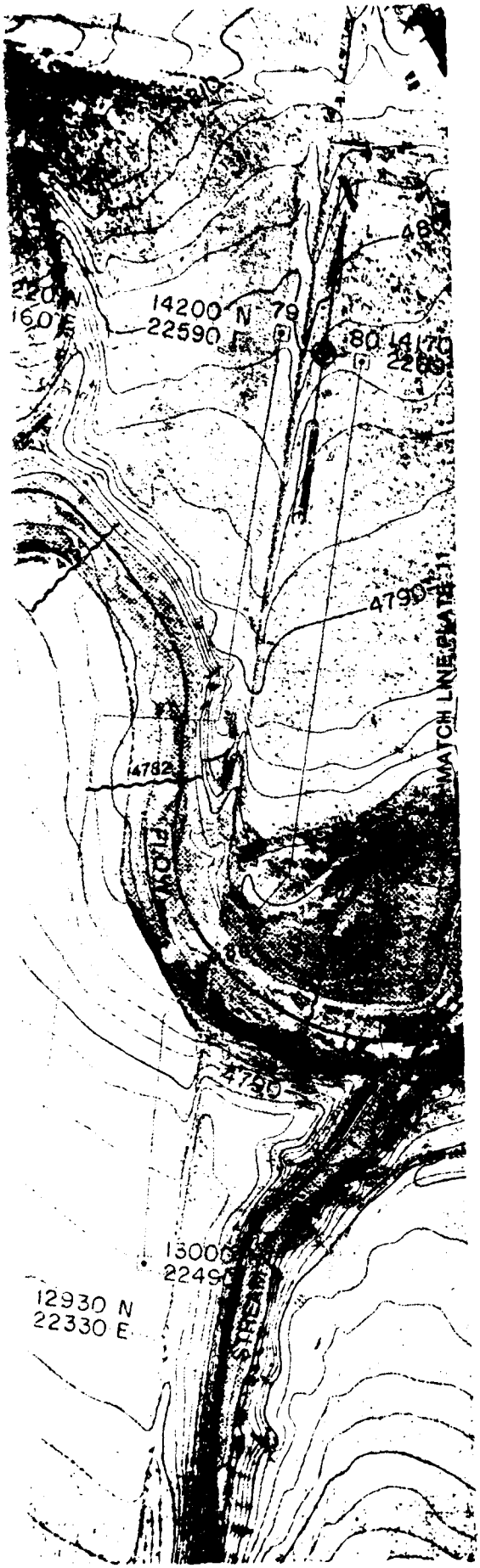

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SPECIAL STUDY
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LARIMER-WELD COUNTIES, COLORADO

SHEEP DRAW
FLOODED AREAS

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCTOBER 1981

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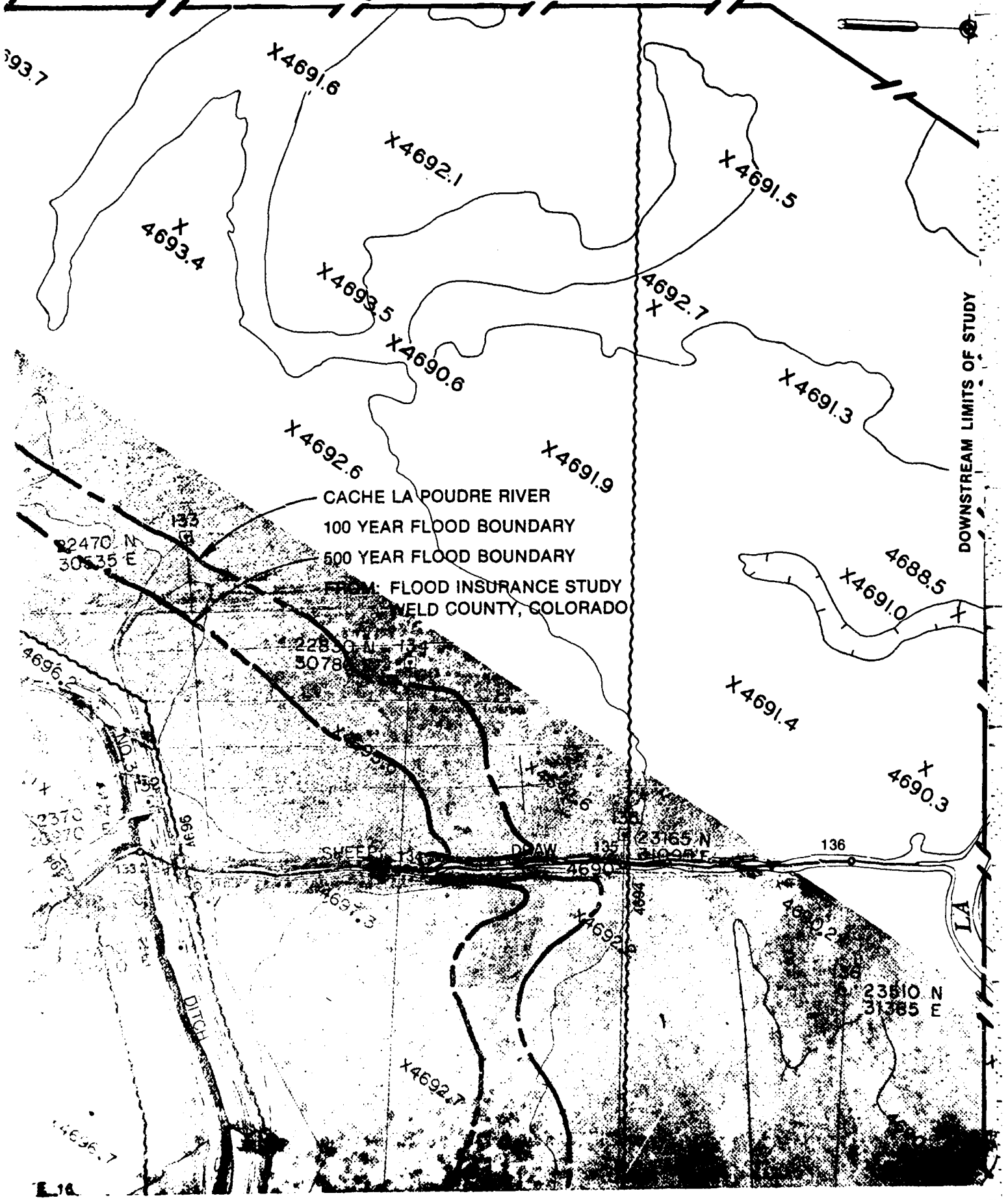

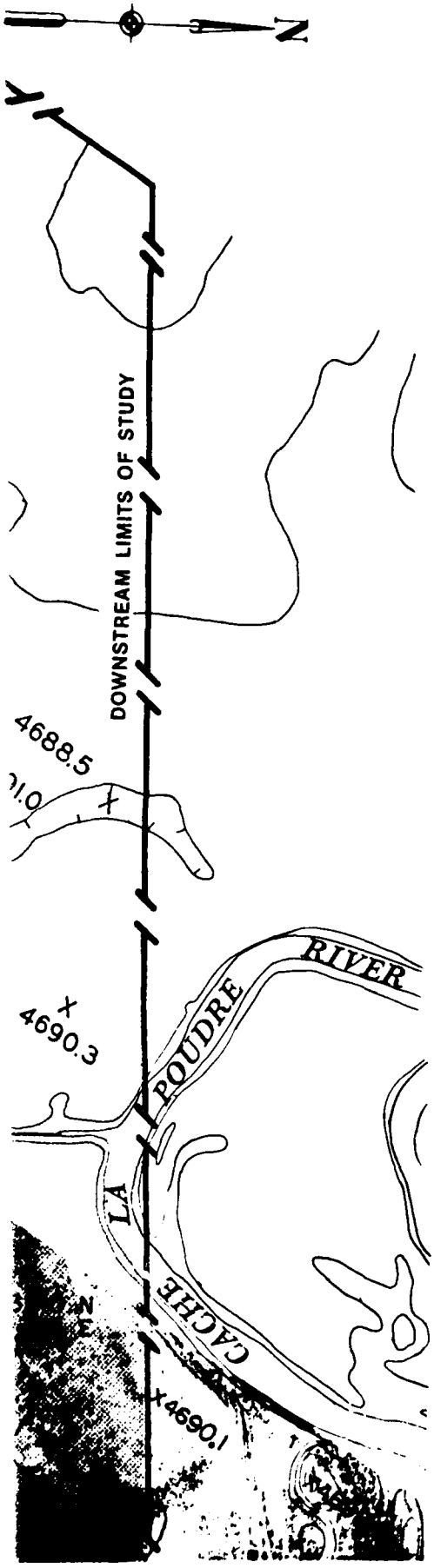

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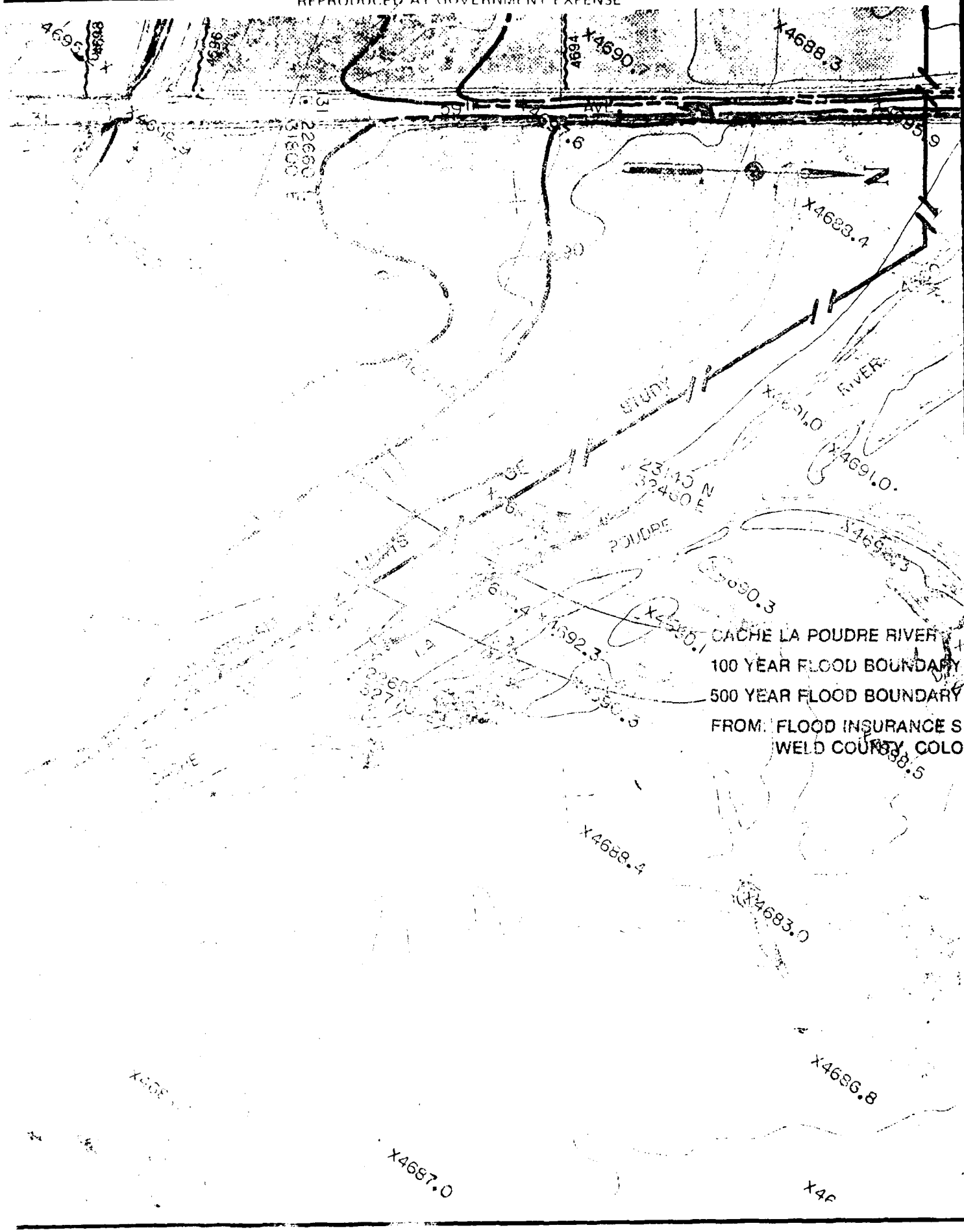
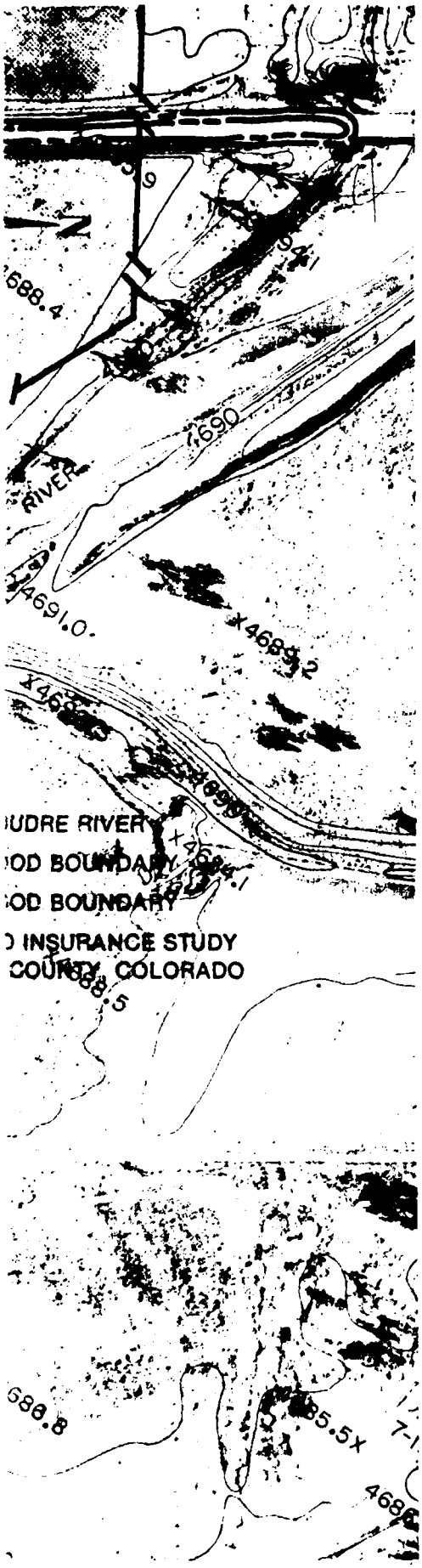
SPECIAL STUDY
CACHE LA POUDRE RIVER BASIN
LARIMER-WELD COUNTIES, COLORADO

SHEEP DRAW
FLOODED AREAS

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCTOBER 1981





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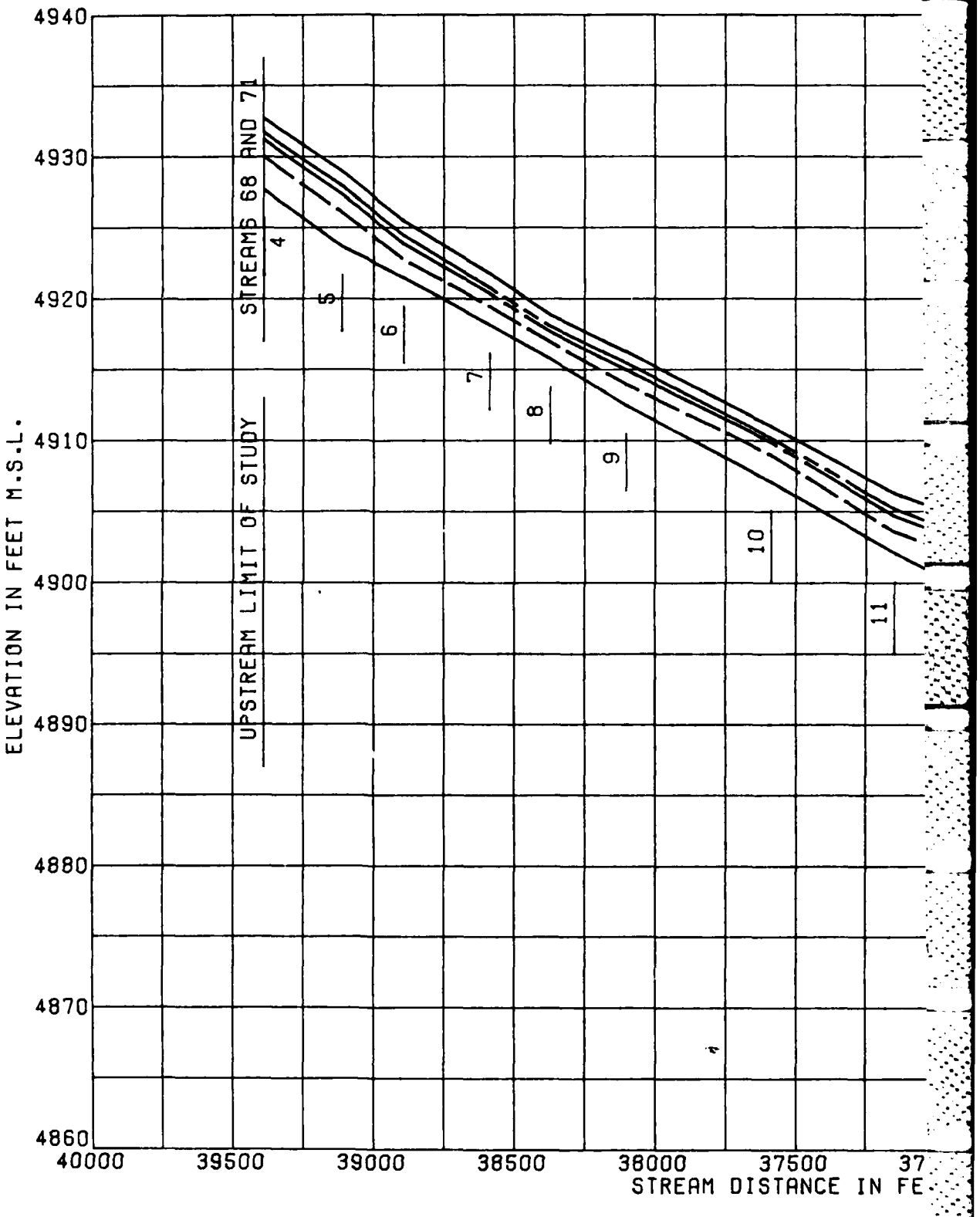
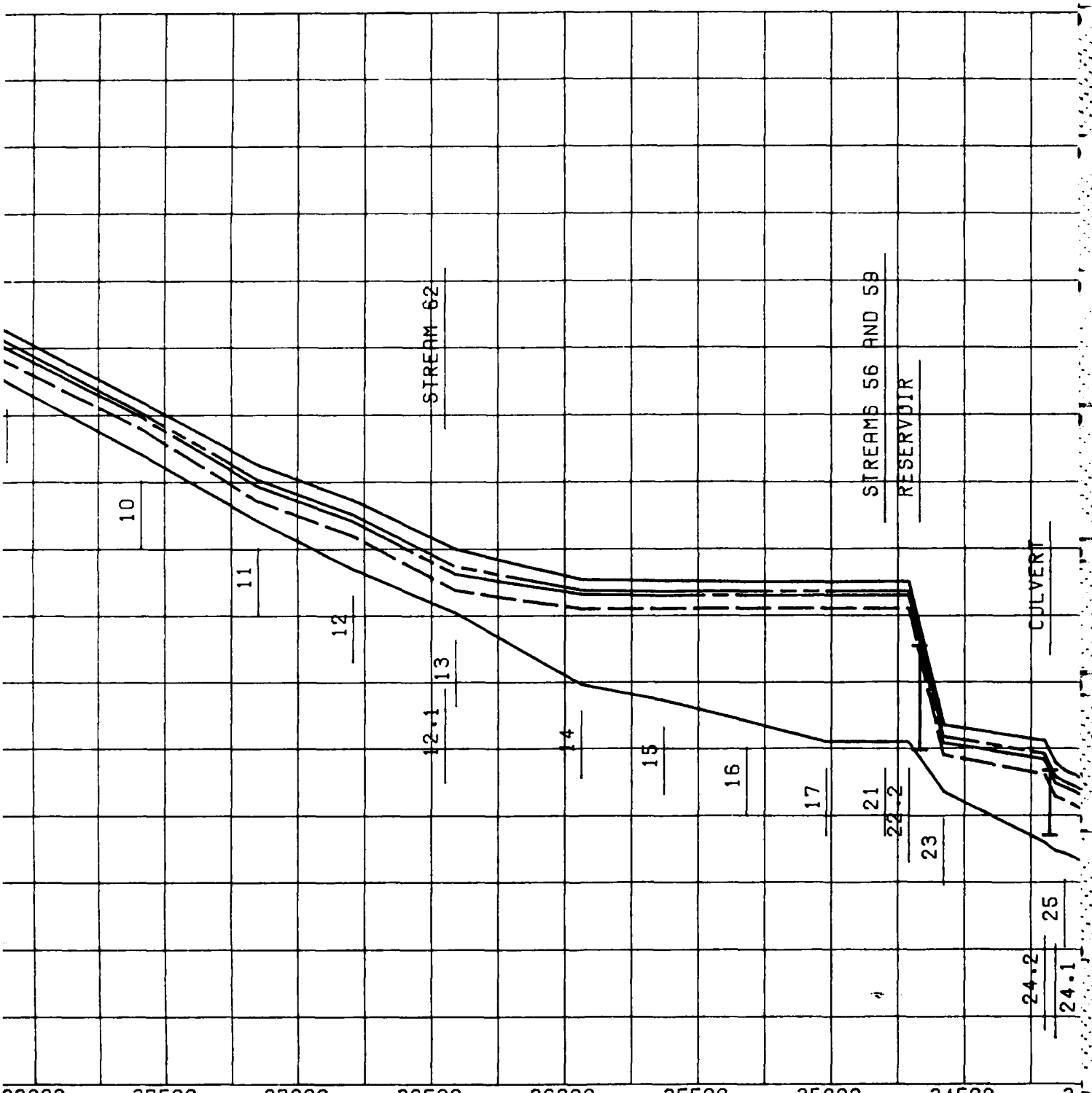
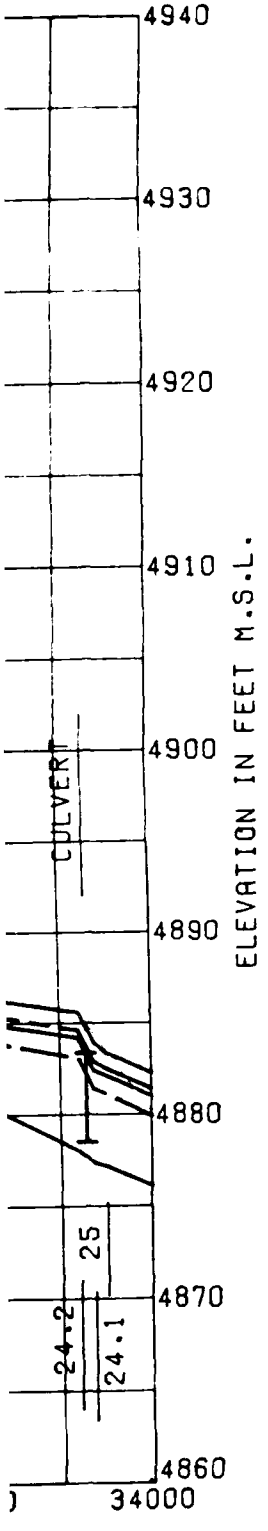
SPECIAL STUDY
CACHE LA POUDRE RIVER BASIN
LARIMER-WELD COUNTIES, COLORADO

SHEEP DRAW
FLOODED AREAS

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCTOBER 1981







LEGEND:

- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- Deck
- Bridge
- Low Steel
- 2 — Reference Point

NOTES:

1. For flood elevations at the reference points, see Table 2.

SPECIAL STUDY
CACHE LA POUDRE RIVER BASIN
LARIMER-WELD COUNTIES, COLORADO

SHEEP DRAW
FLOOD PROFILES

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCTOBER 1981

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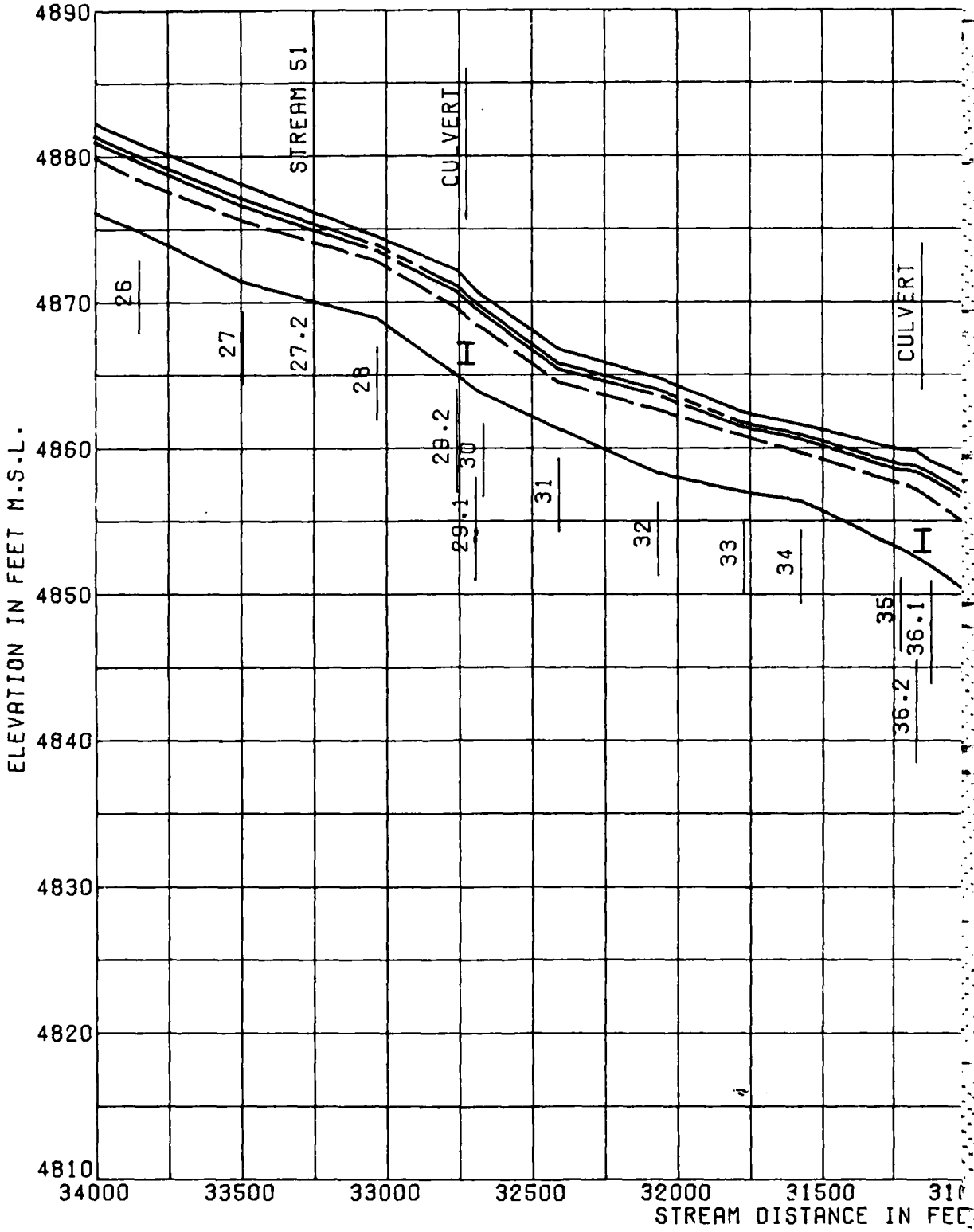

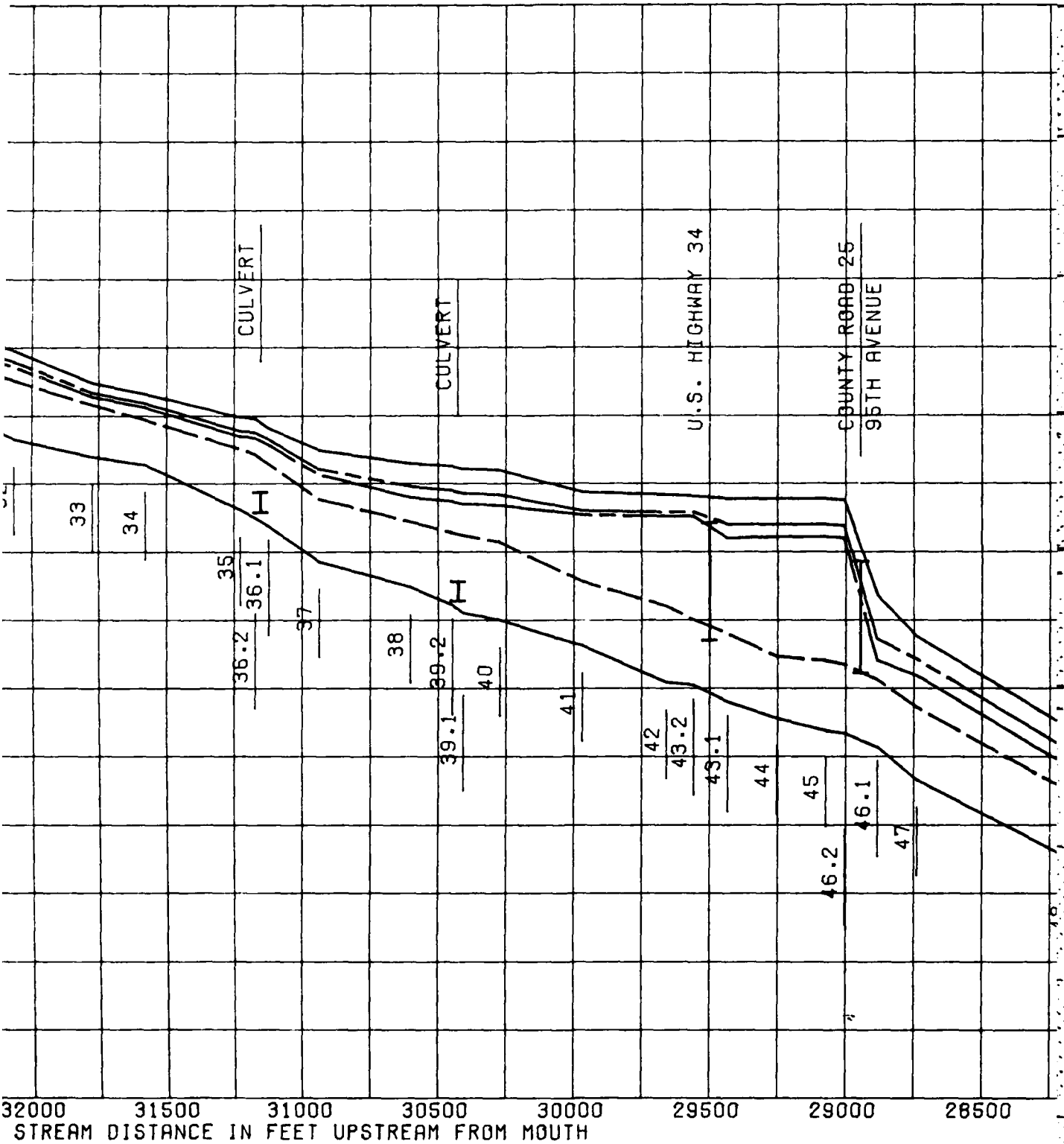

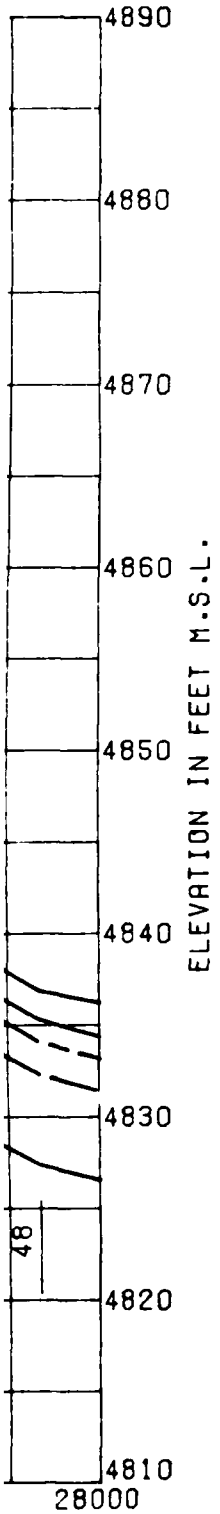

LEGEND:

- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- Deck
- Bridge
- Low Steel
- Reference Point

NOTES:

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SPECIAL STUDY
CACHE LA POUDRE RIVER BASIN
LARIMER-WELD COUNTIES, COLORADO

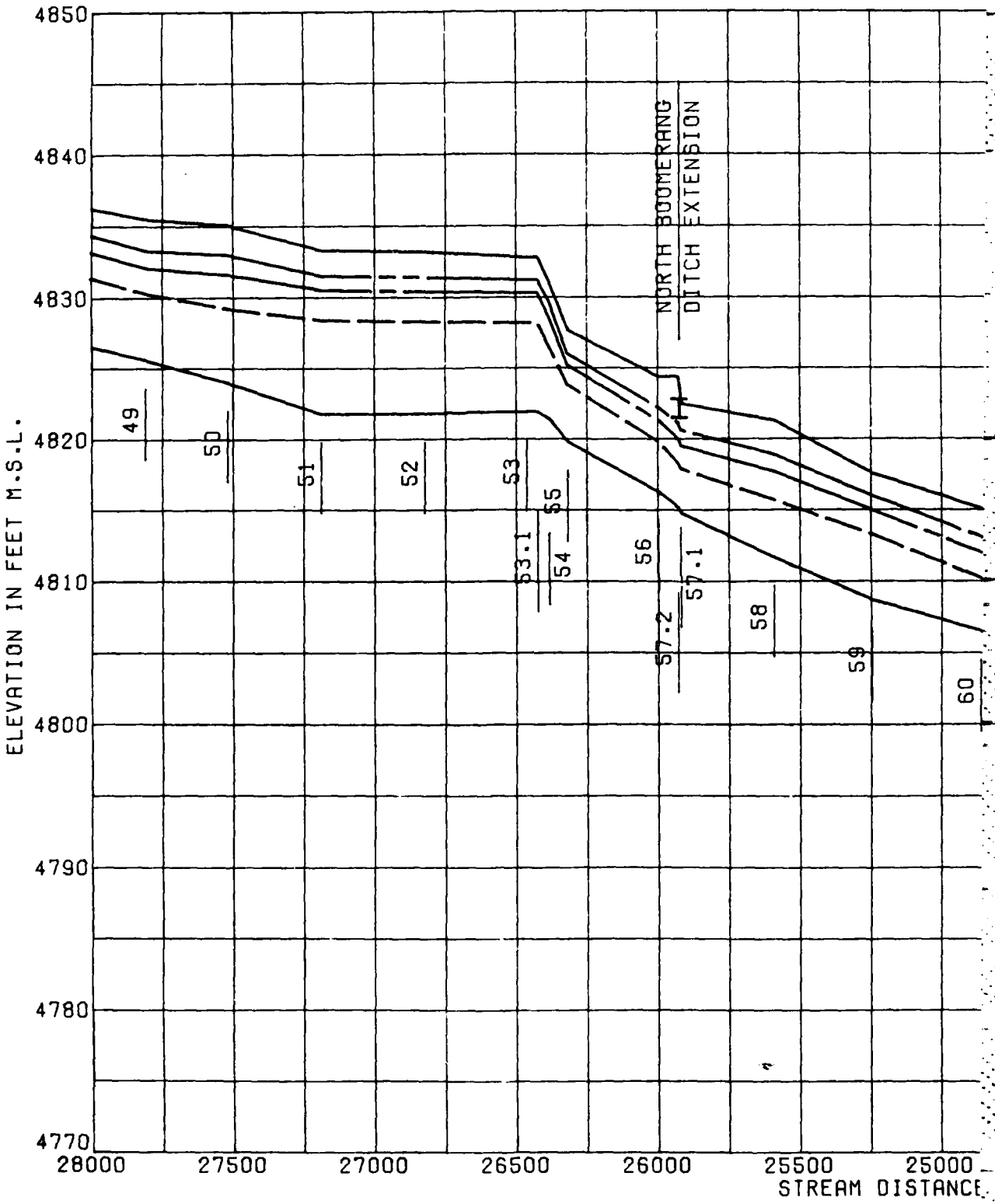
SHEEP DRAW
FLOOD PROFILES

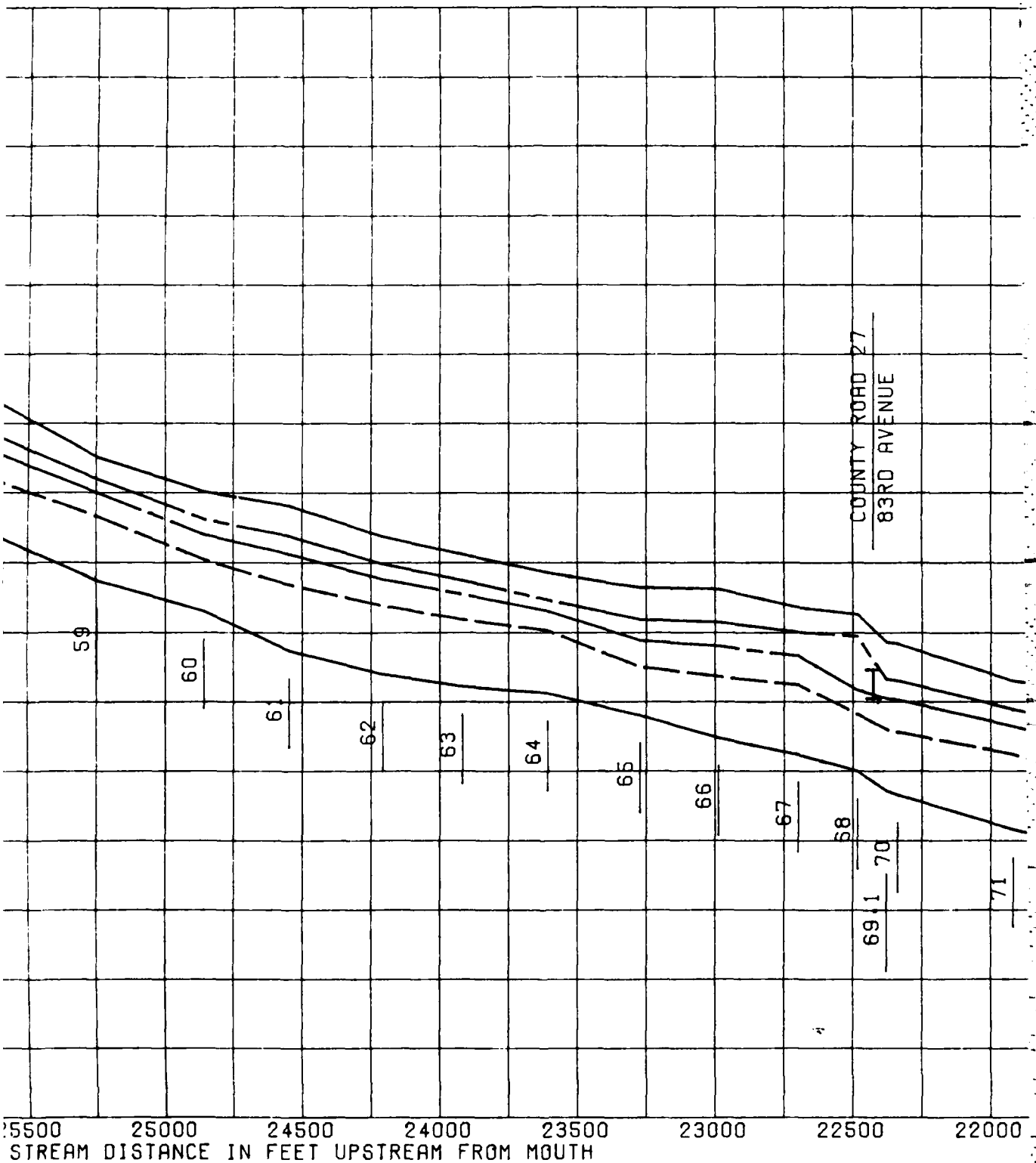
U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCTOBER 1981

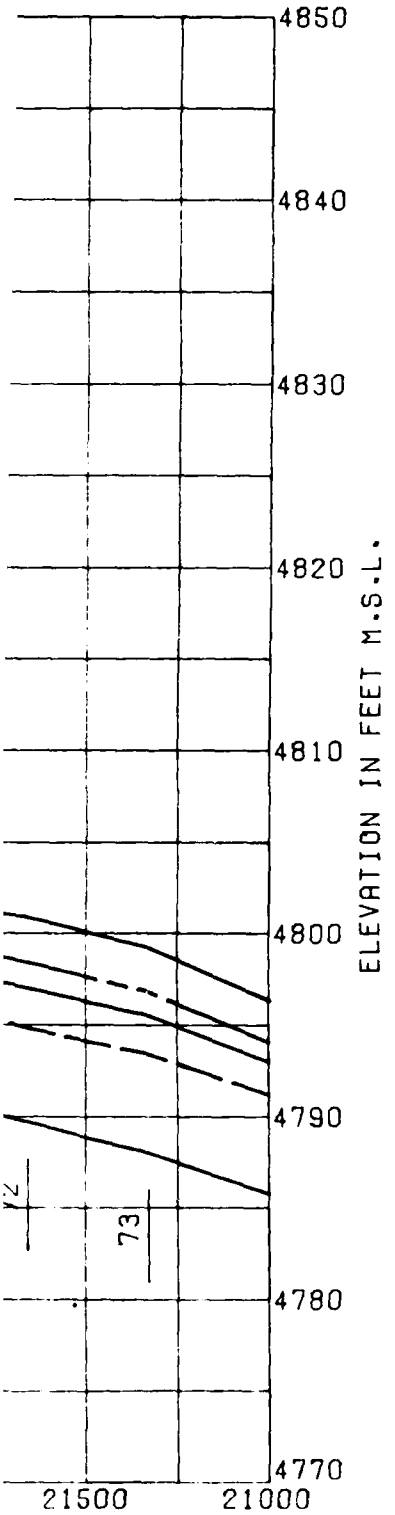
3

VOLUME III

PLATE 18







LEGEND:

- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- Deck
- Bridge
- Low Steel
- Reference Point

NOTES:

1. For flood elevations at the reference points, see Table 2.
2. A low embankment extends part way across the channel at reference point 53.1.

SPECIAL STUDY
CACHE LA POUDRE RIVER BASIN
LARIMER-WELD COUNTIES, COLORADO

SHEEP DRAW
FLOOD PROFILES

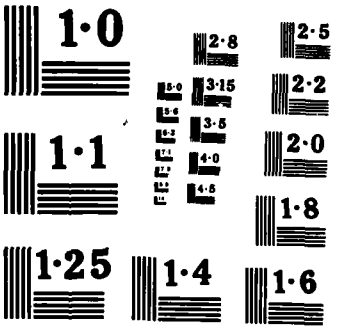
U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCTOBER 1981

3

VOLUME III PLATE 19

AD-A151 768 CACHE LA POUDRE RIVER BASIN LARIMER - WELD COUNTIES COLORADO VOLUME 3 FLOOD PLAIN ANALYSIS SHEEP DRAW(U) CORPS OF ENGINEERS OMAHA NE OCT 81 2/2

UNCLASSIFIED F/G 13/2 NL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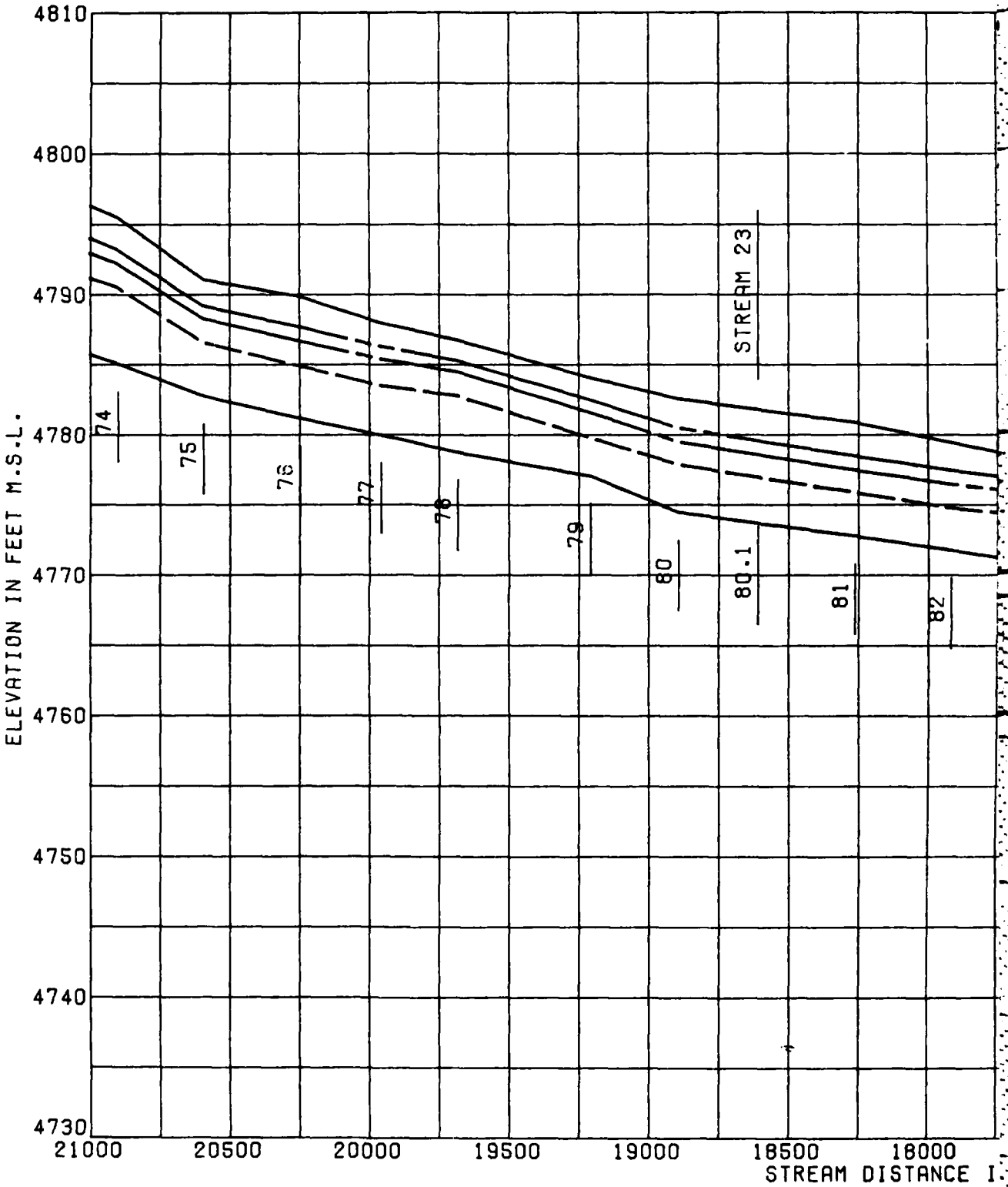

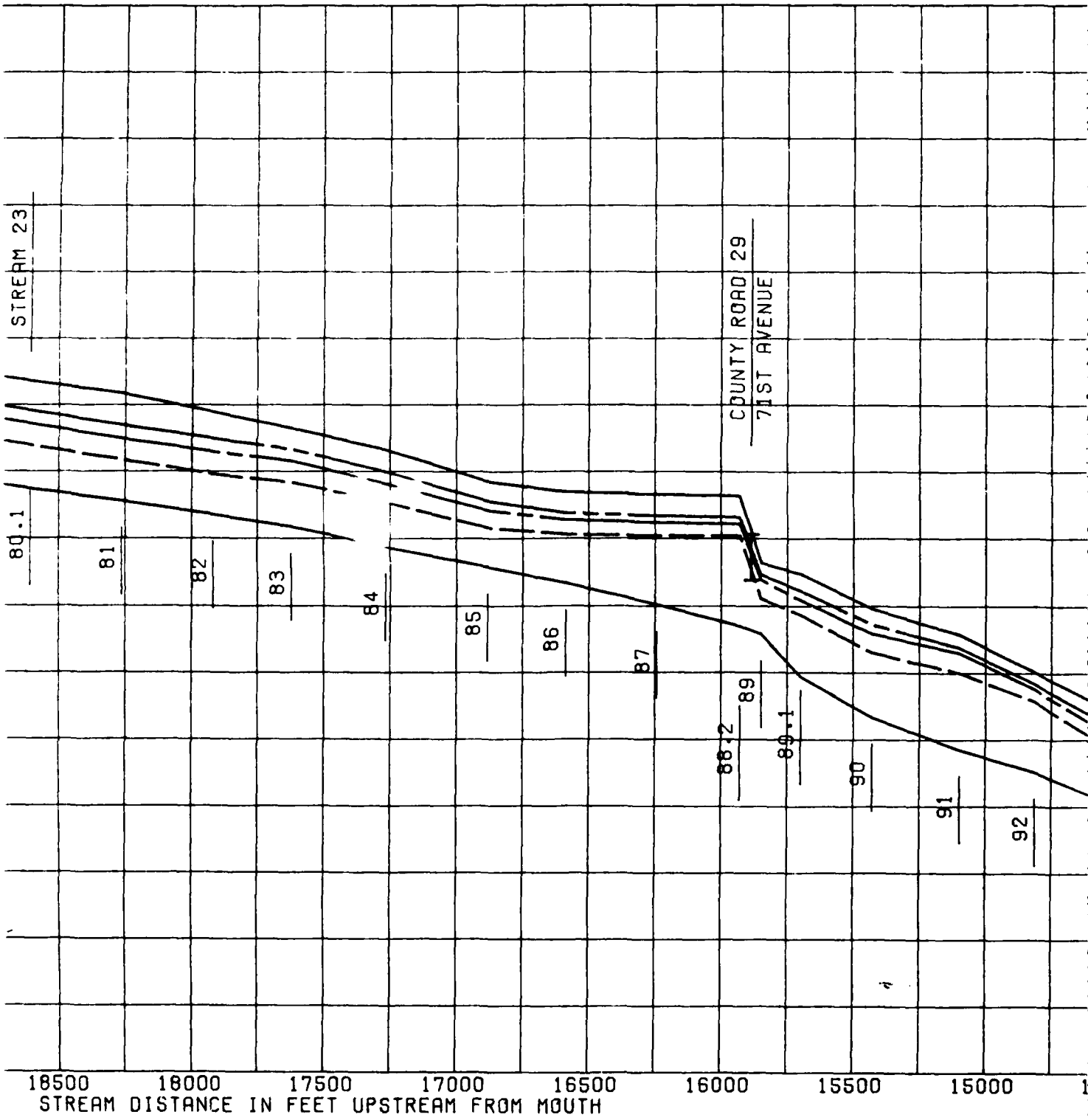

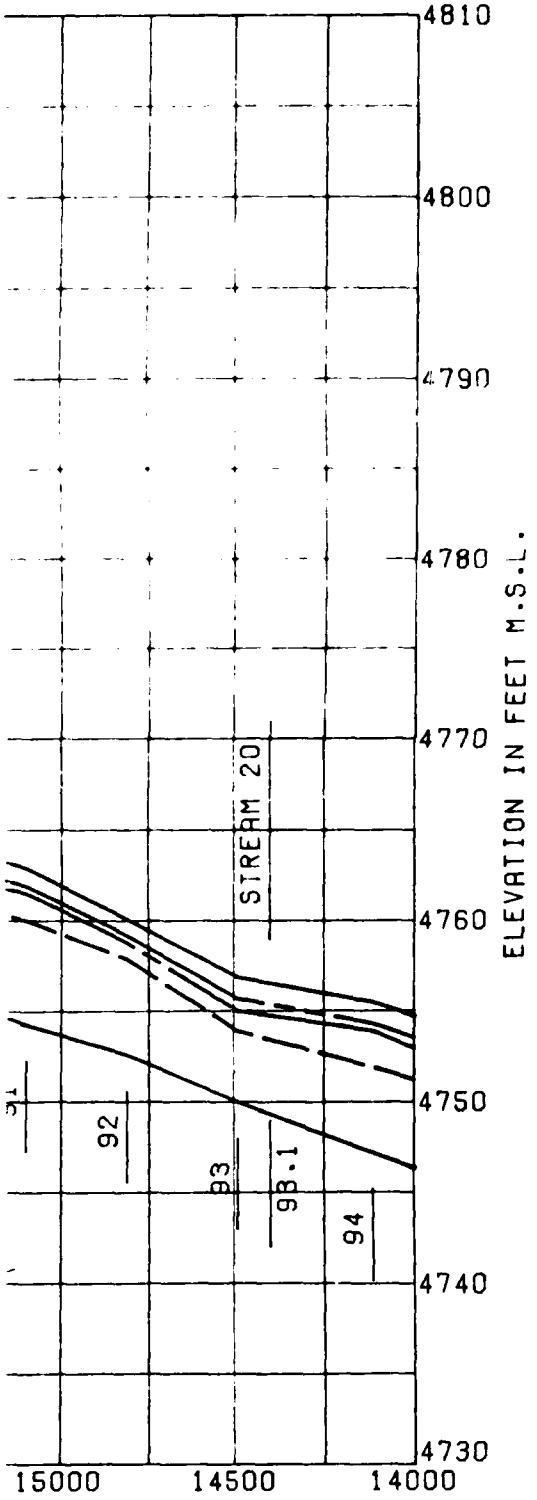

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- 10 YEAR FLOOD
- Deck
- Bridge
- Low Steel
- 2 — Reference Point

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SPECIAL STUDY
CACHE LA POUDRE RIVER BASIN
LARIMER-WELD COUNTIES, COLORADO

SHEEP DRAW
FLOOD PROFILES

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCTOBER 1981

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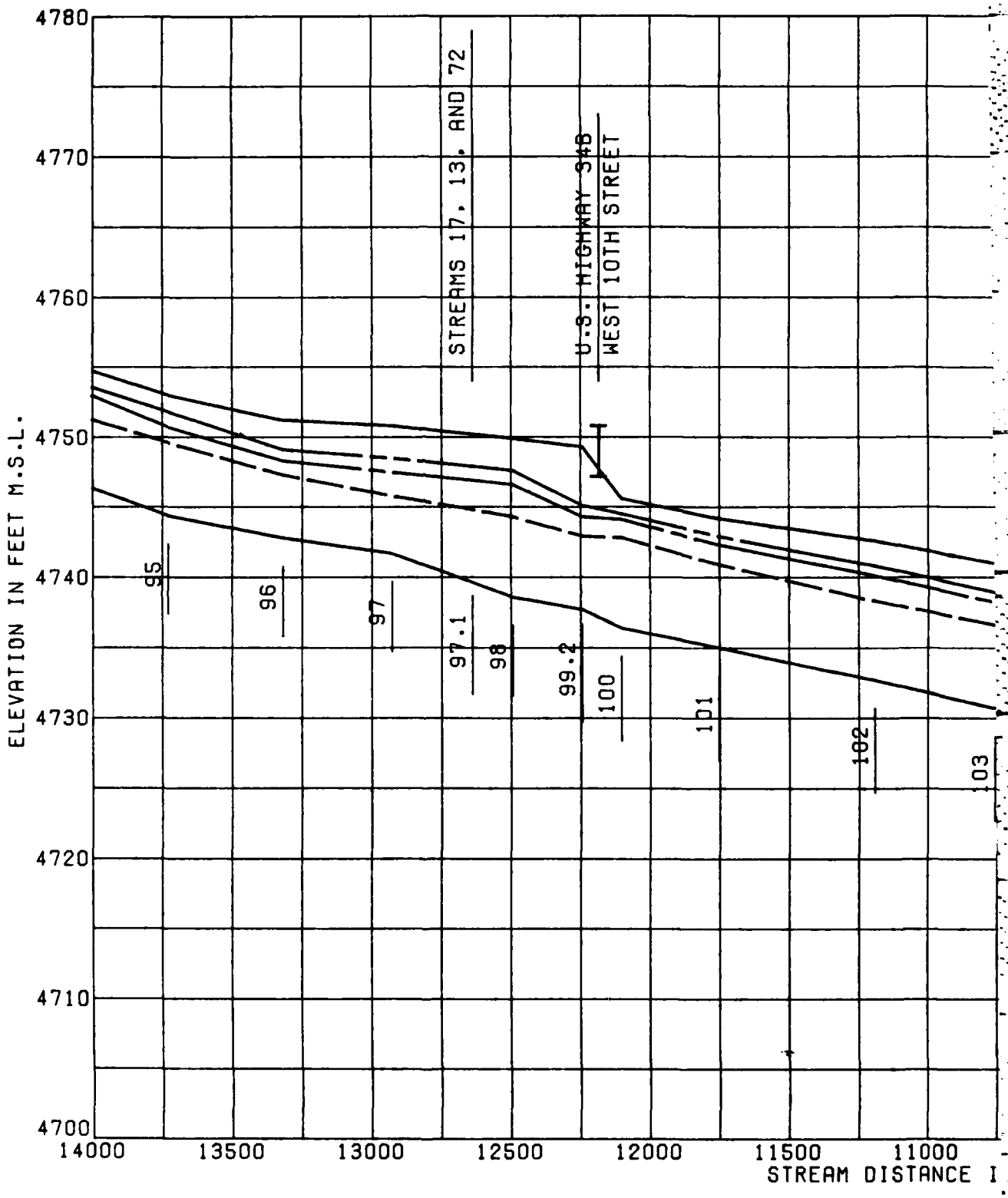

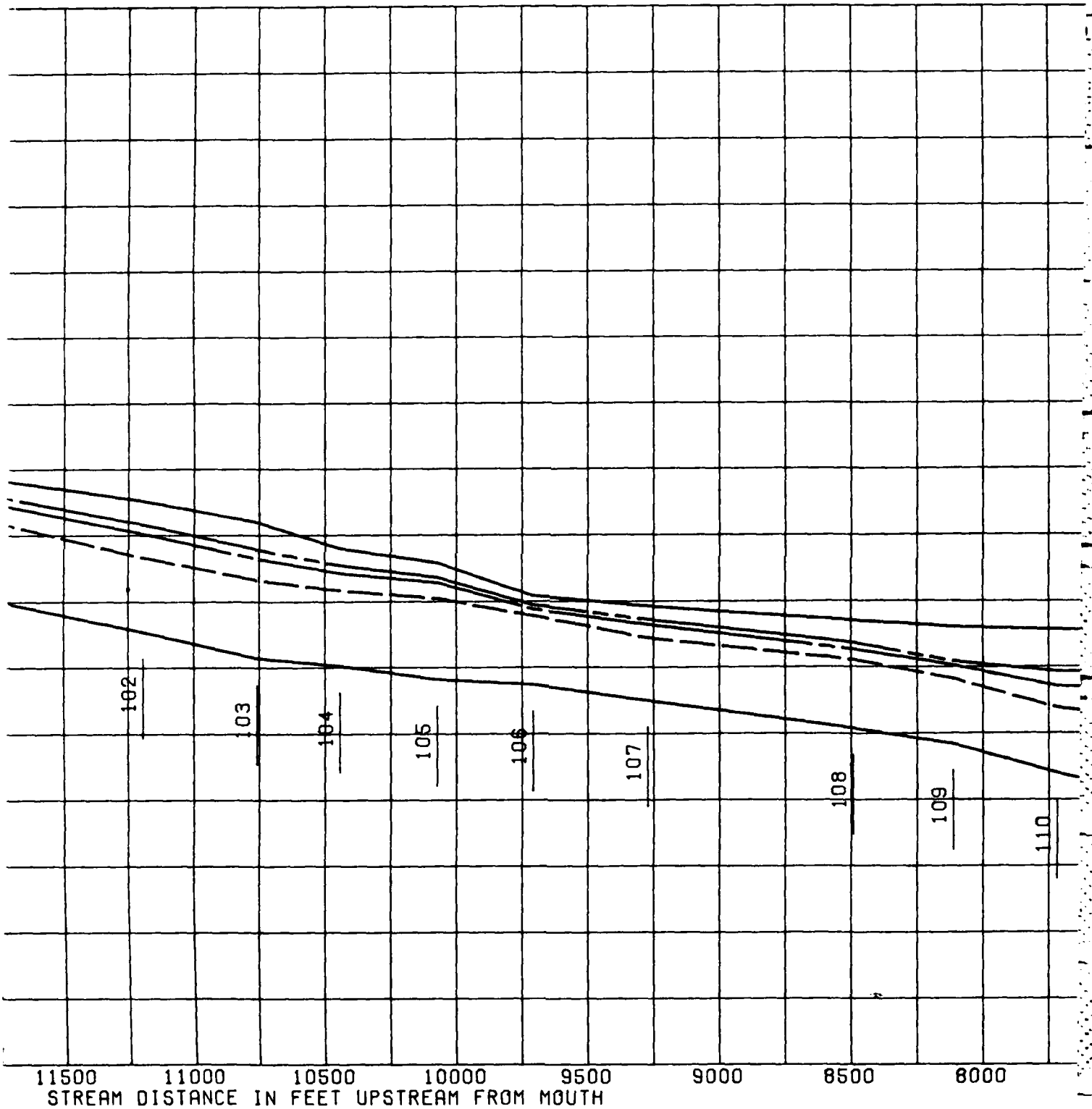

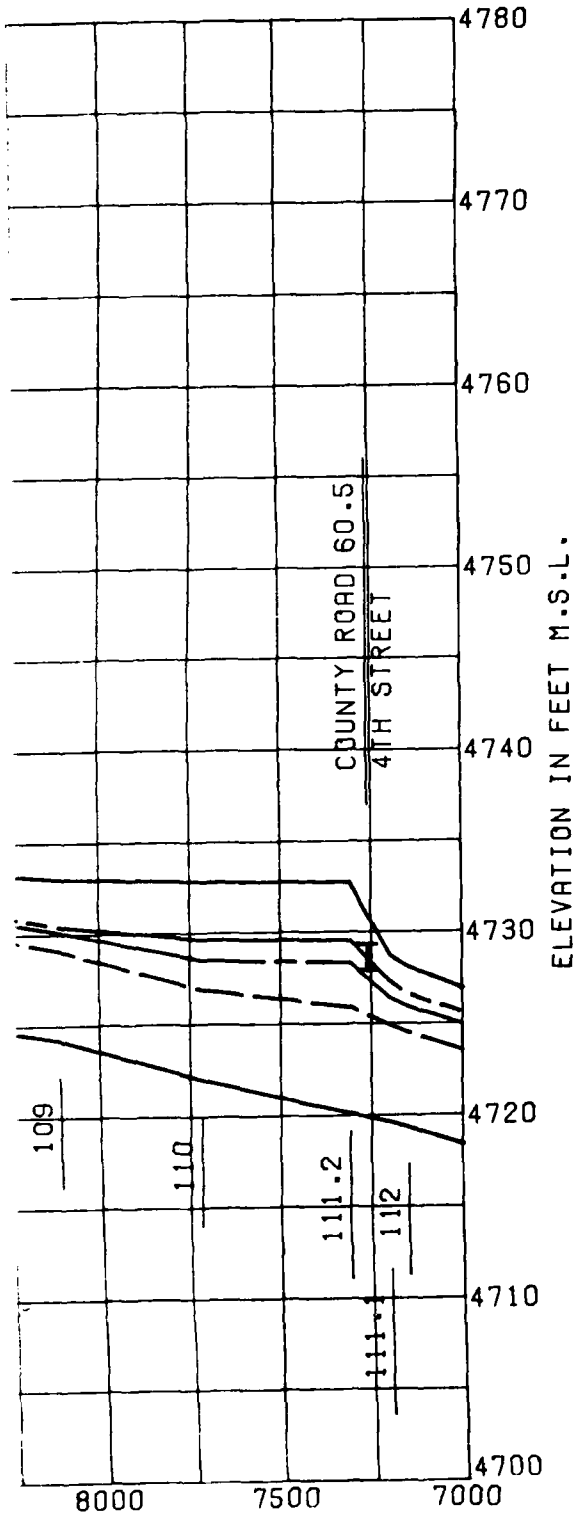

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- 10 YEAR FLOOD

- Deck
- Bridge
- Low Steel

2 — Reference Point

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SHEEP DRAW
FLOOD PROFILES

U.S. ARMY ENGINEER DISTRICT, OMAHA
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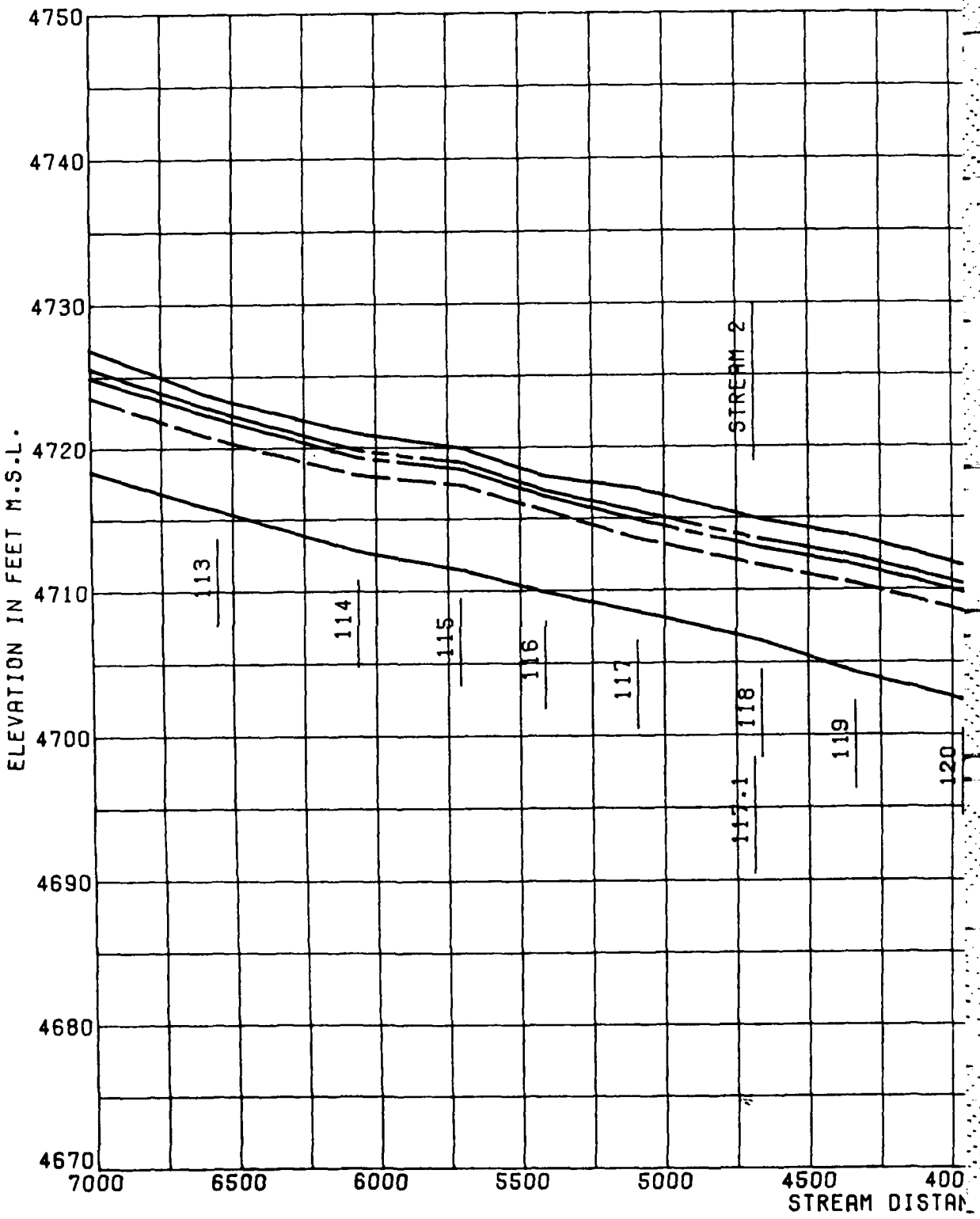

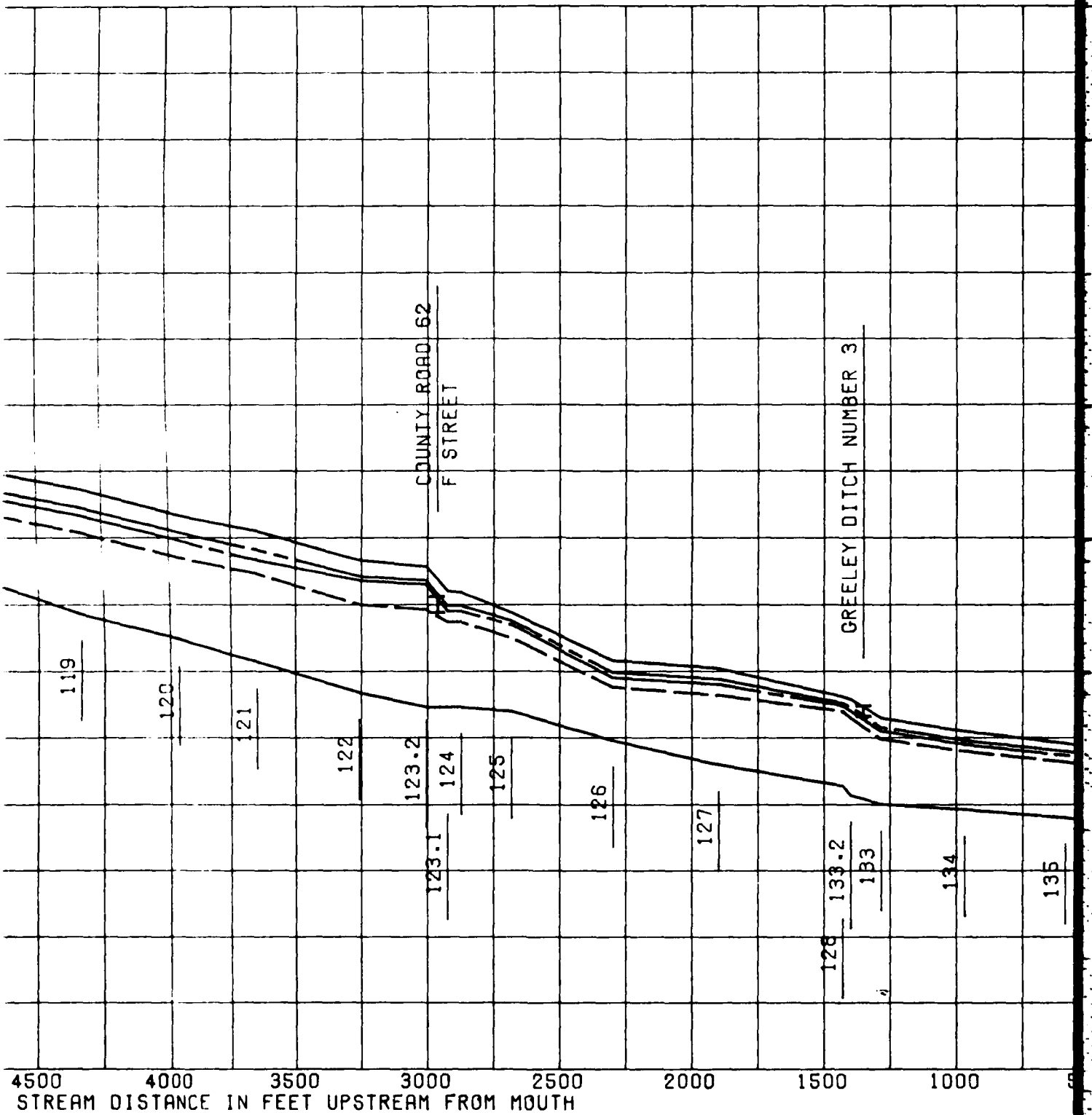

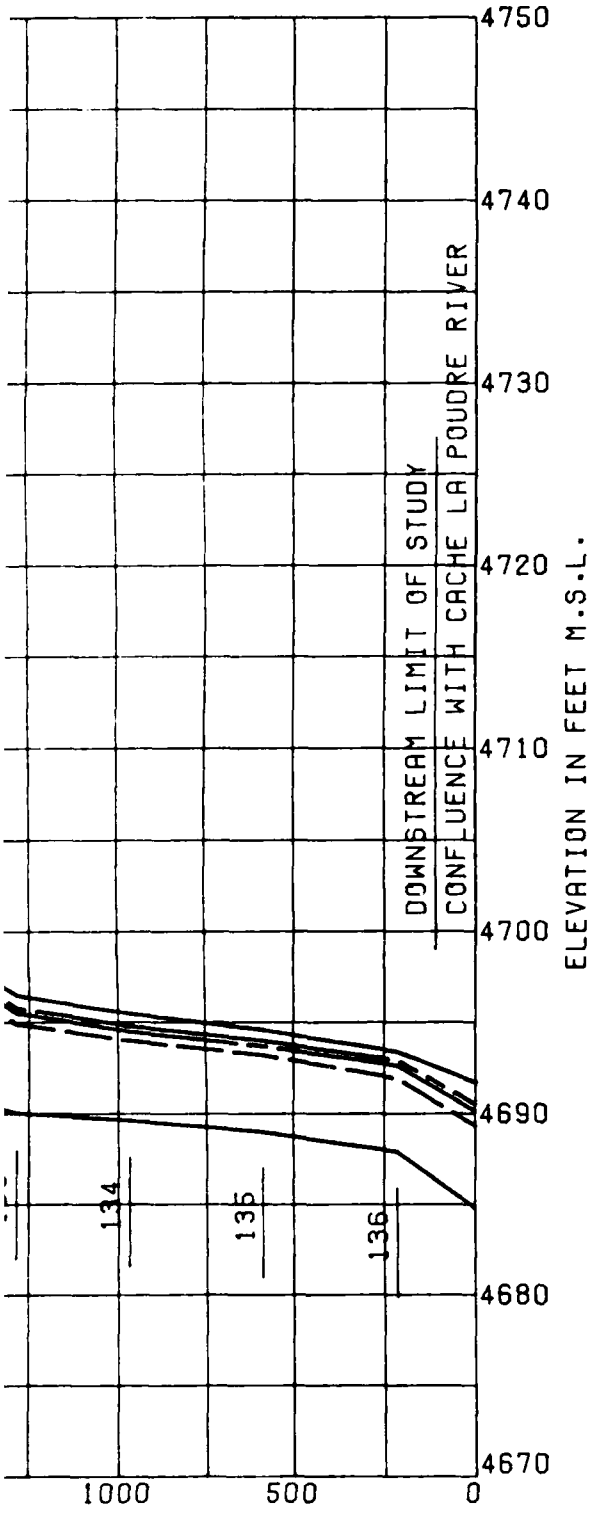

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U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
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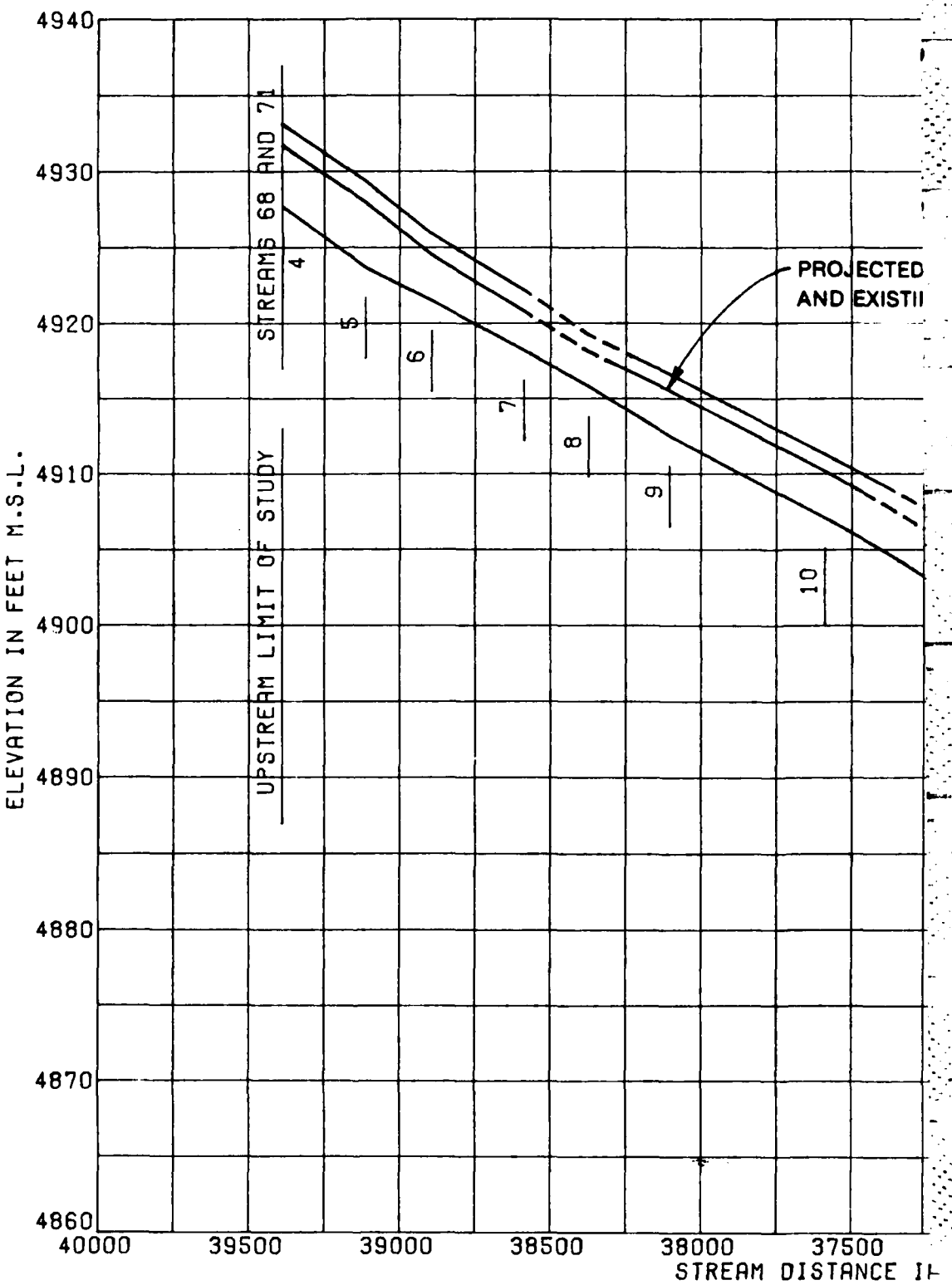

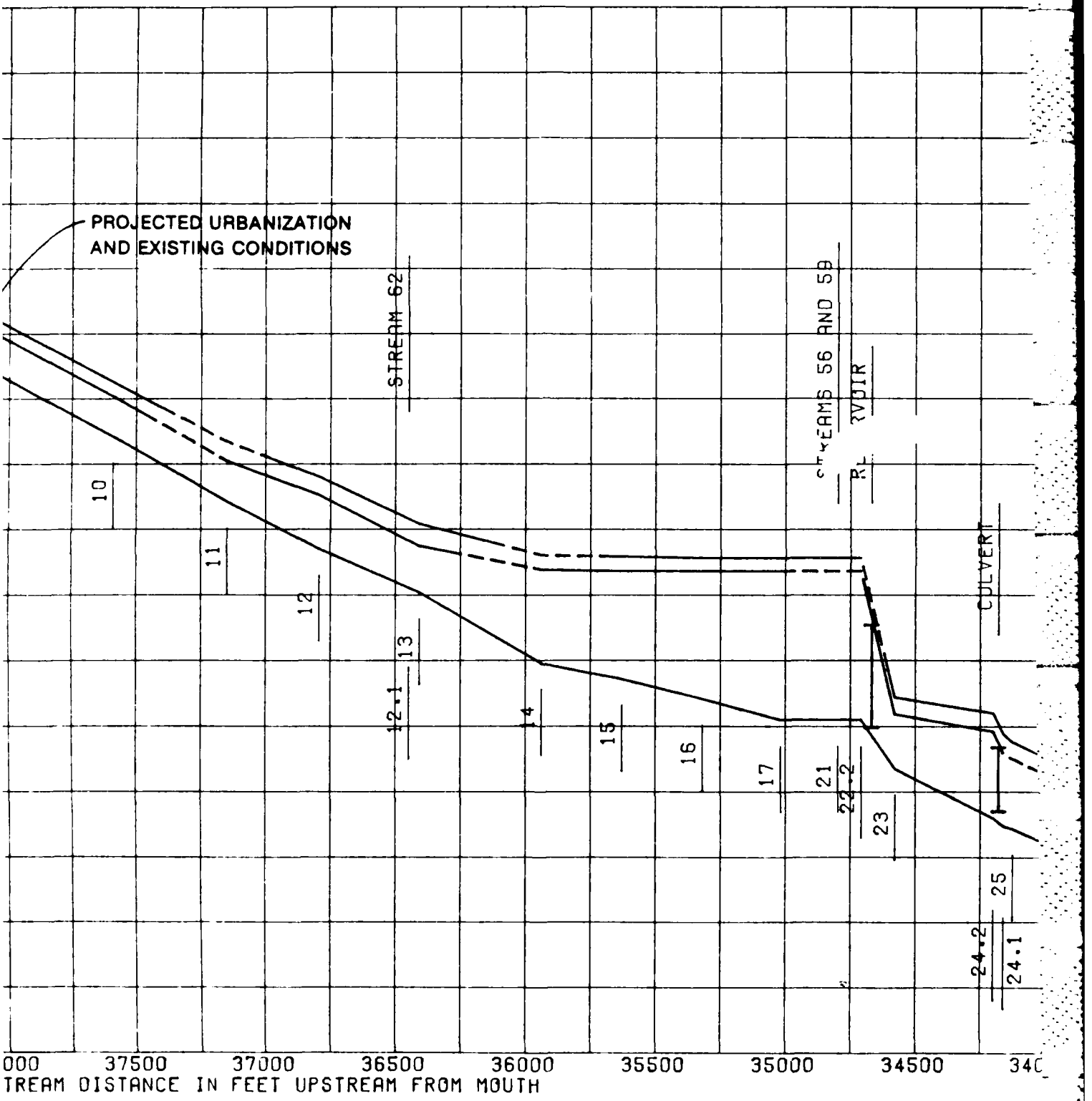

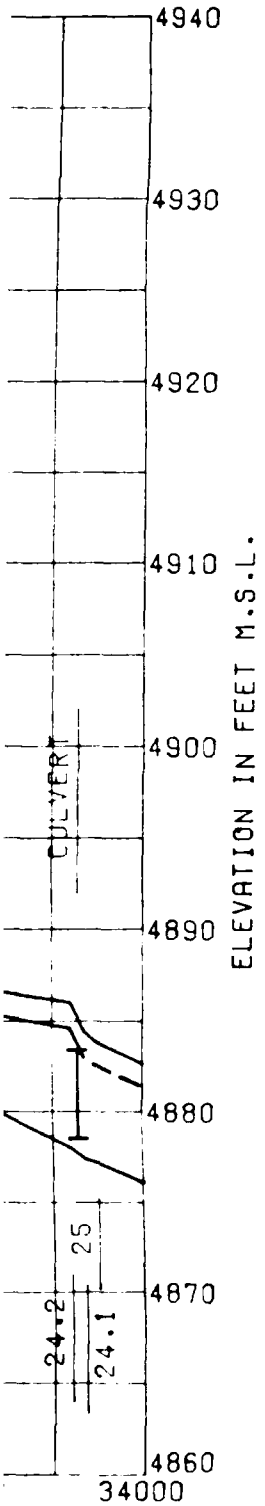

LEGEND:

100 YEAR FLOOD
TOTAL URBANIZATION

100 YEAR FLOOD
PROJECTED URBANIZATION

100 YEAR FLOOD
EXISTING CONDITIONS

Deck
Bridge
Low Steel

2 Reference Point

NOTES:

1. For flood elevations at the reference points, see Table 3.

SPECIAL STUDY
CACHE LA POUDRE RIVER BASIN
LARIMER-WELD COUNTIES, COLORADO

SHEEP DRAW
EFFECT OF LAND USE ON FLOOD PROFILES

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCTOBER 1981

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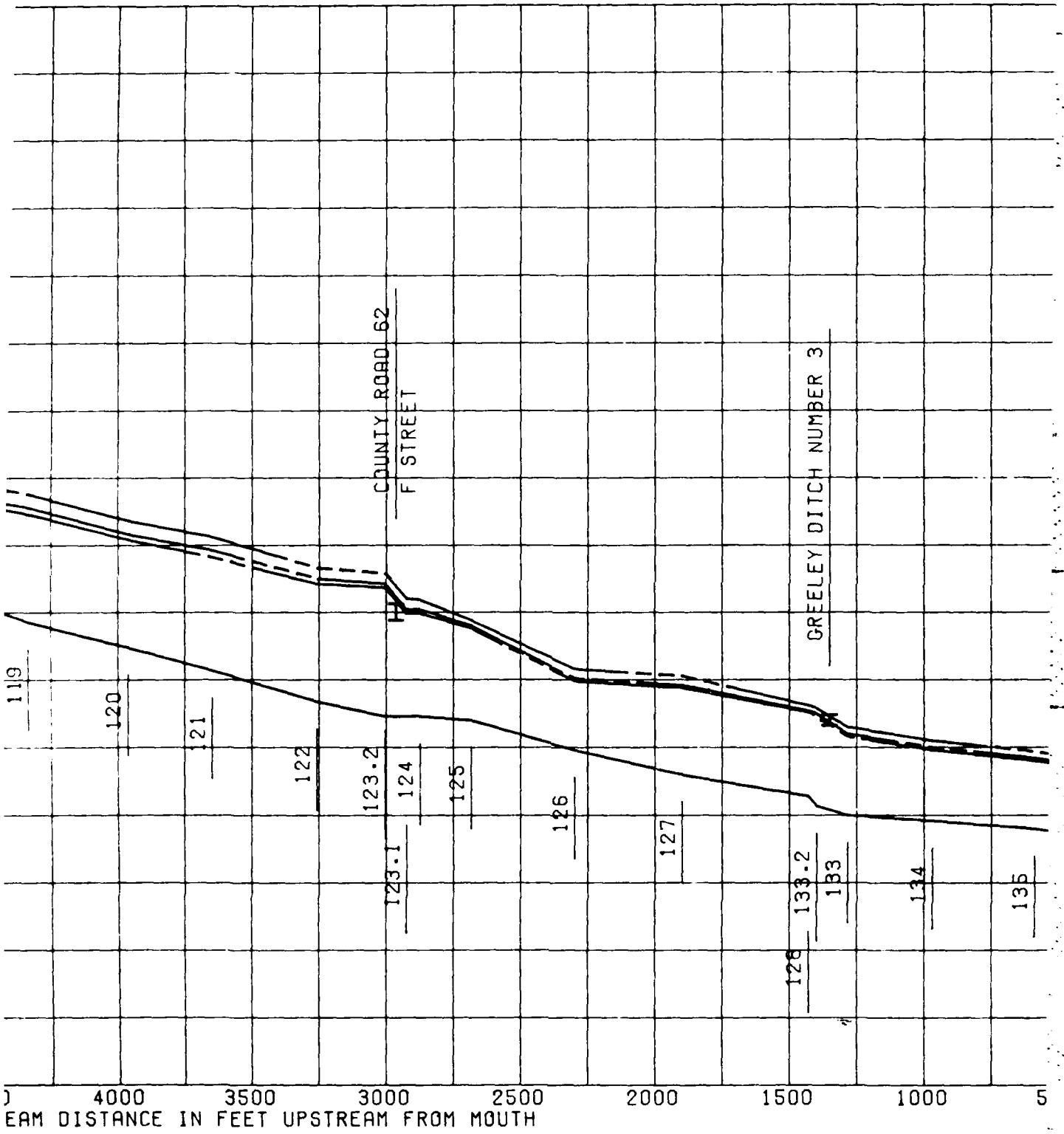

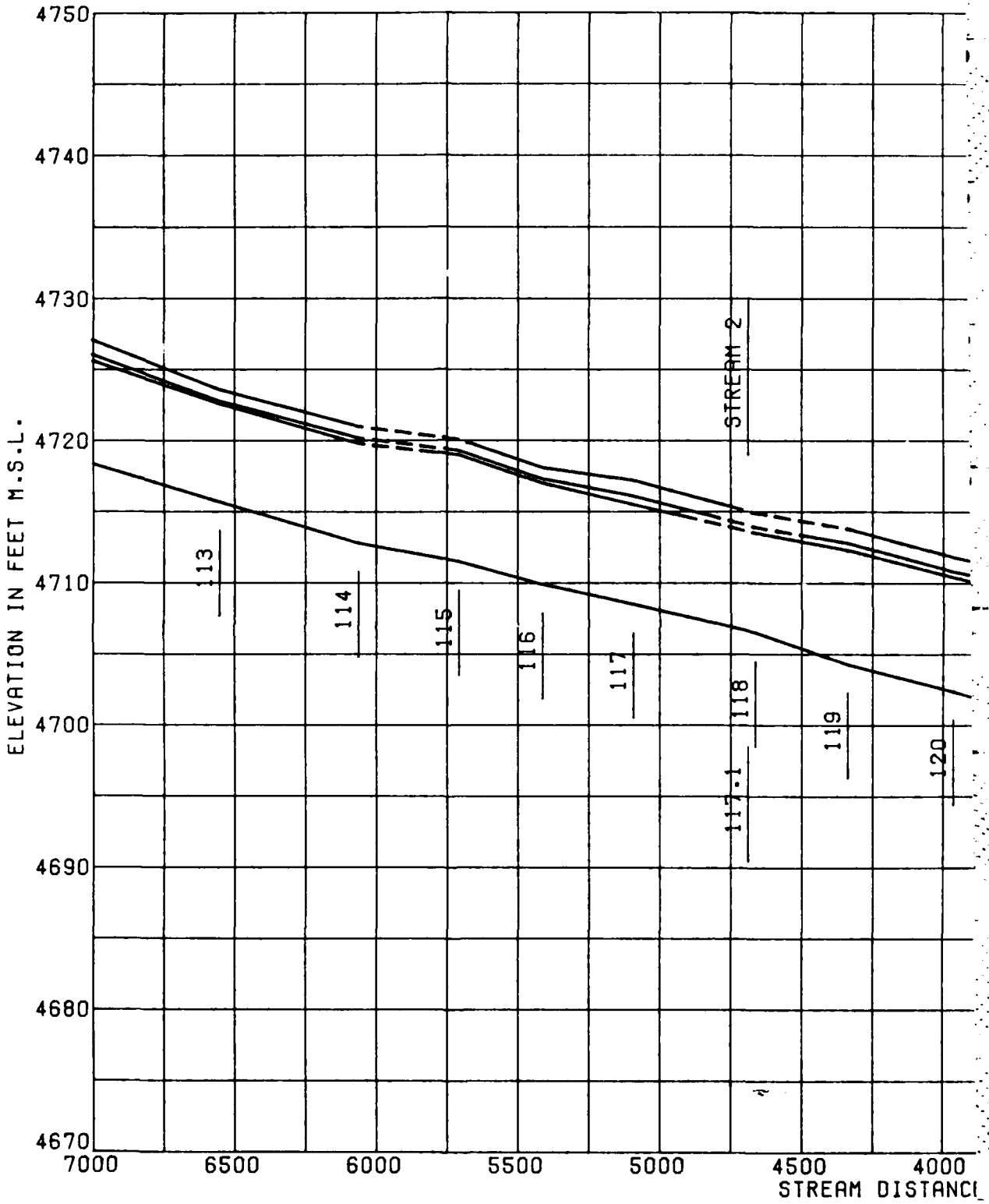

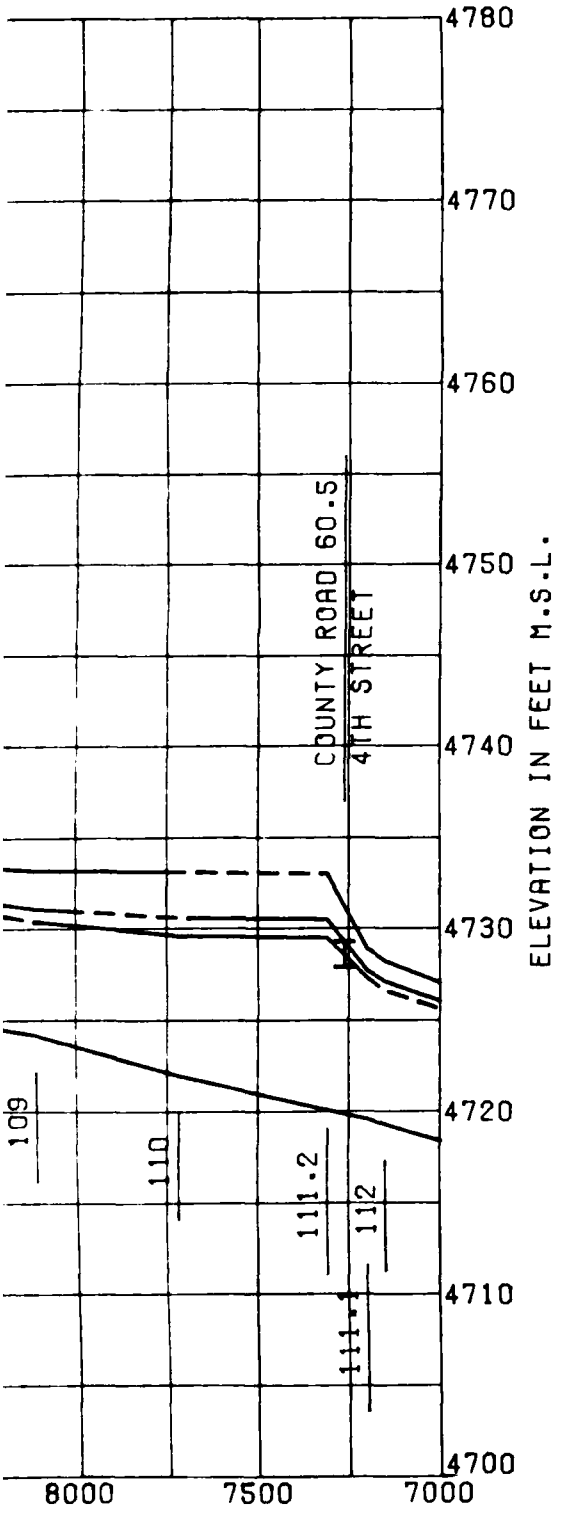

LEGEND:

- 100 YEAR FLOOD TOTAL URBANIZATION
- 100 YEAR FLOOD PROJECTED URBANIZATION
- 100 YEAR FLOOD EXISTING CONDITIONS
- Deck
- Bridge
- Low Steel
- 2 — Reference Point

NOTES:

1. For flood elevations at the reference points, see Table 3.

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CACHE LA POUDRE RIVER BASIN
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SHEEP DRAW
EFFECT OF LAND USE ON FLOOD PROFILES

U.S. ARMY ENGINEER DISTRICT, OMAHA
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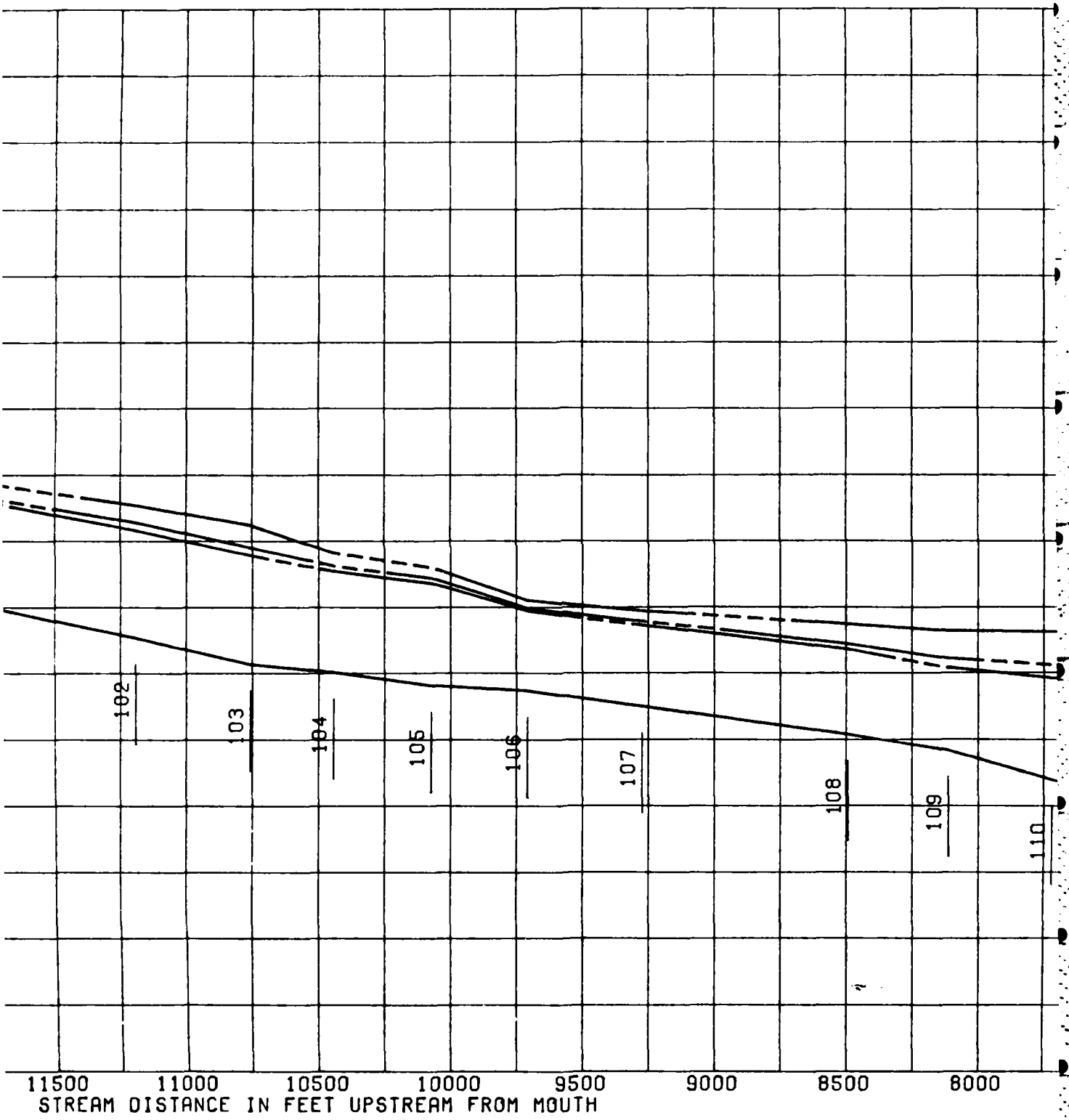

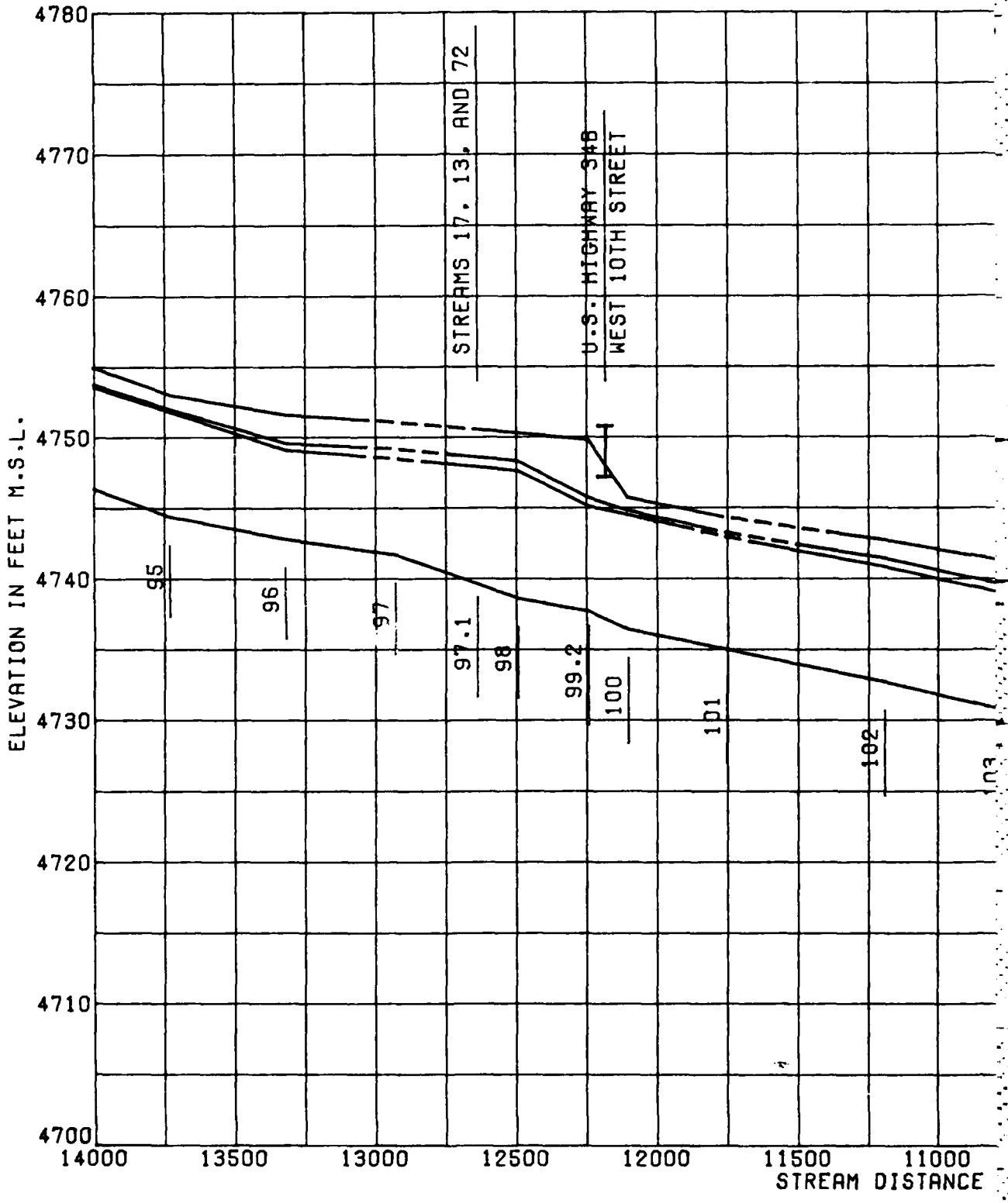

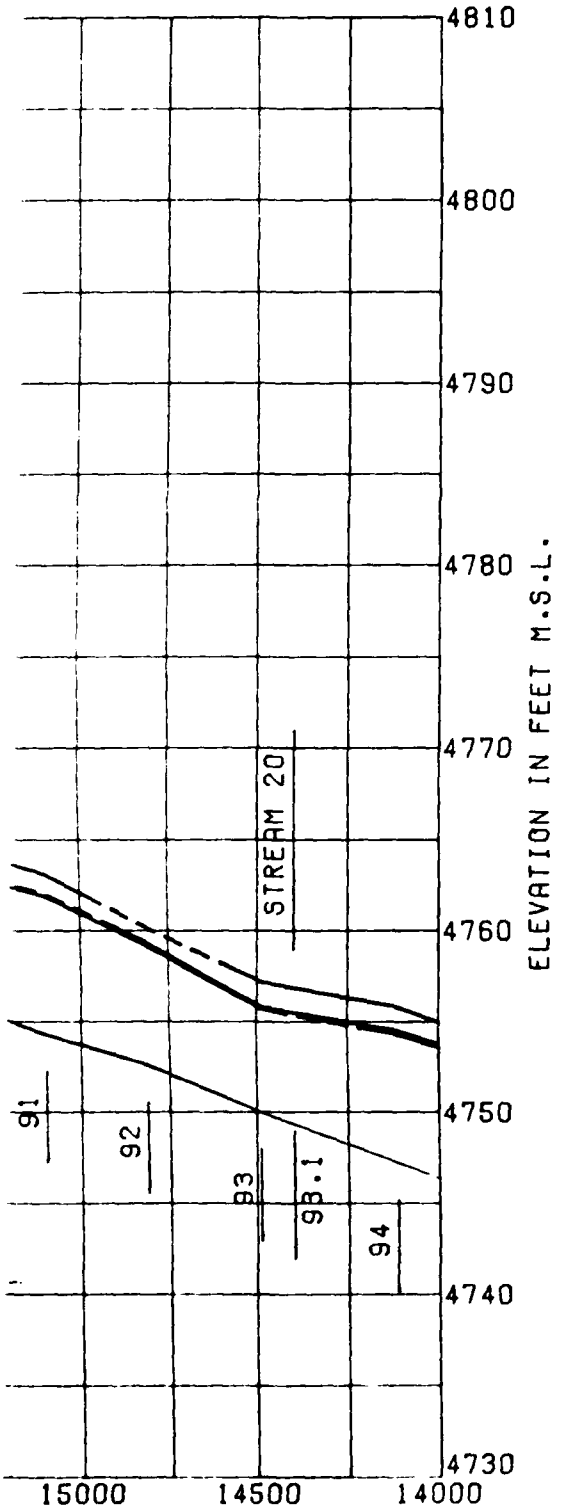

LEGEND:

- 100 YEAR FLOOD TOTAL URBANIZATION
- 100 YEAR FLOOD PROJECTED URBANIZATION
- 100 YEAR FLOOD EXISTING CONDITIONS
- Deck
- Bridge
- Low Steel
- 2 — Reference Point

NOTES:

1. For flood elevations at the reference points, see Table 3.

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SHEEP DRAW
EFFECT OF LAND USE ON FLOOD PROFILES

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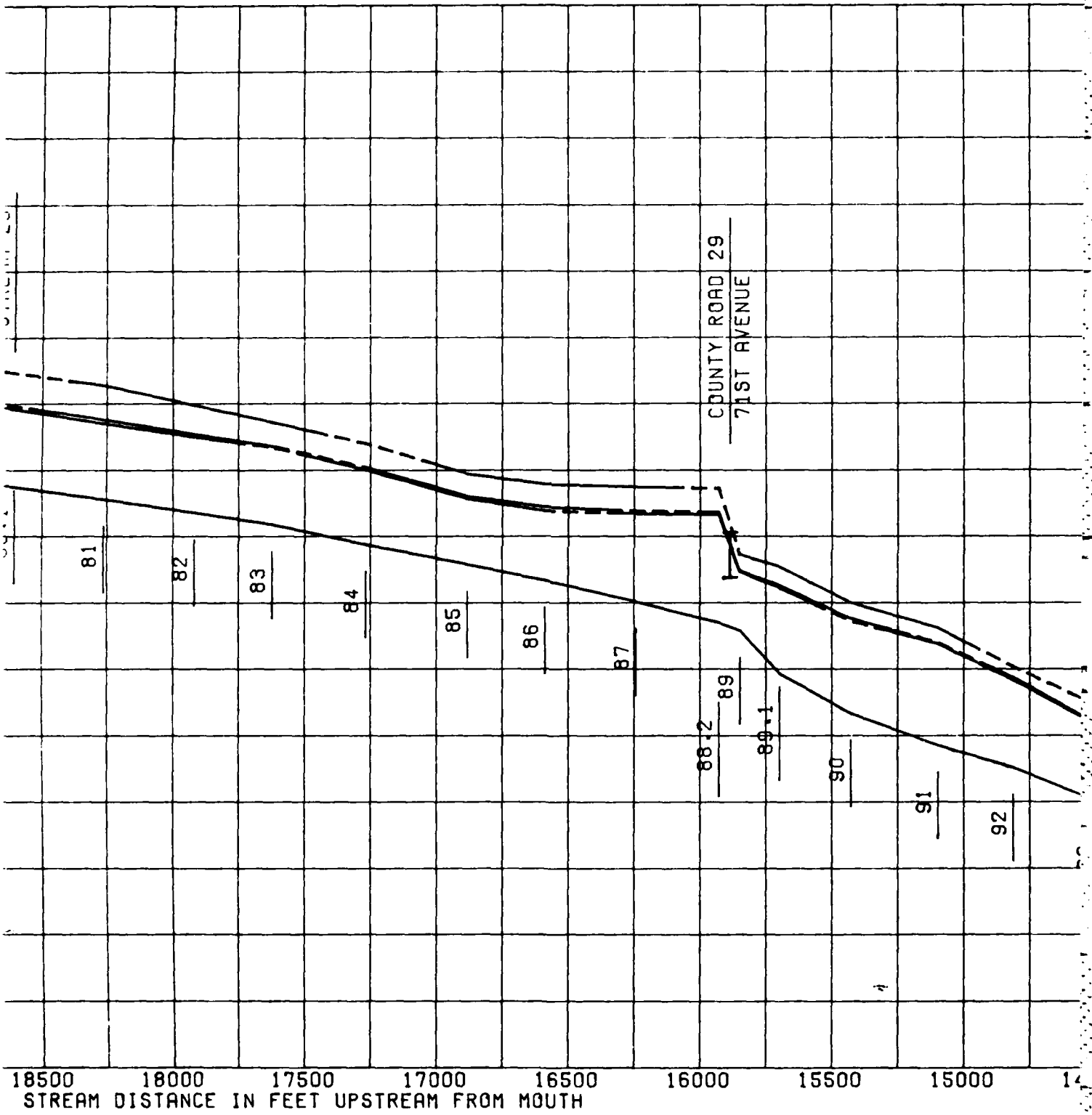

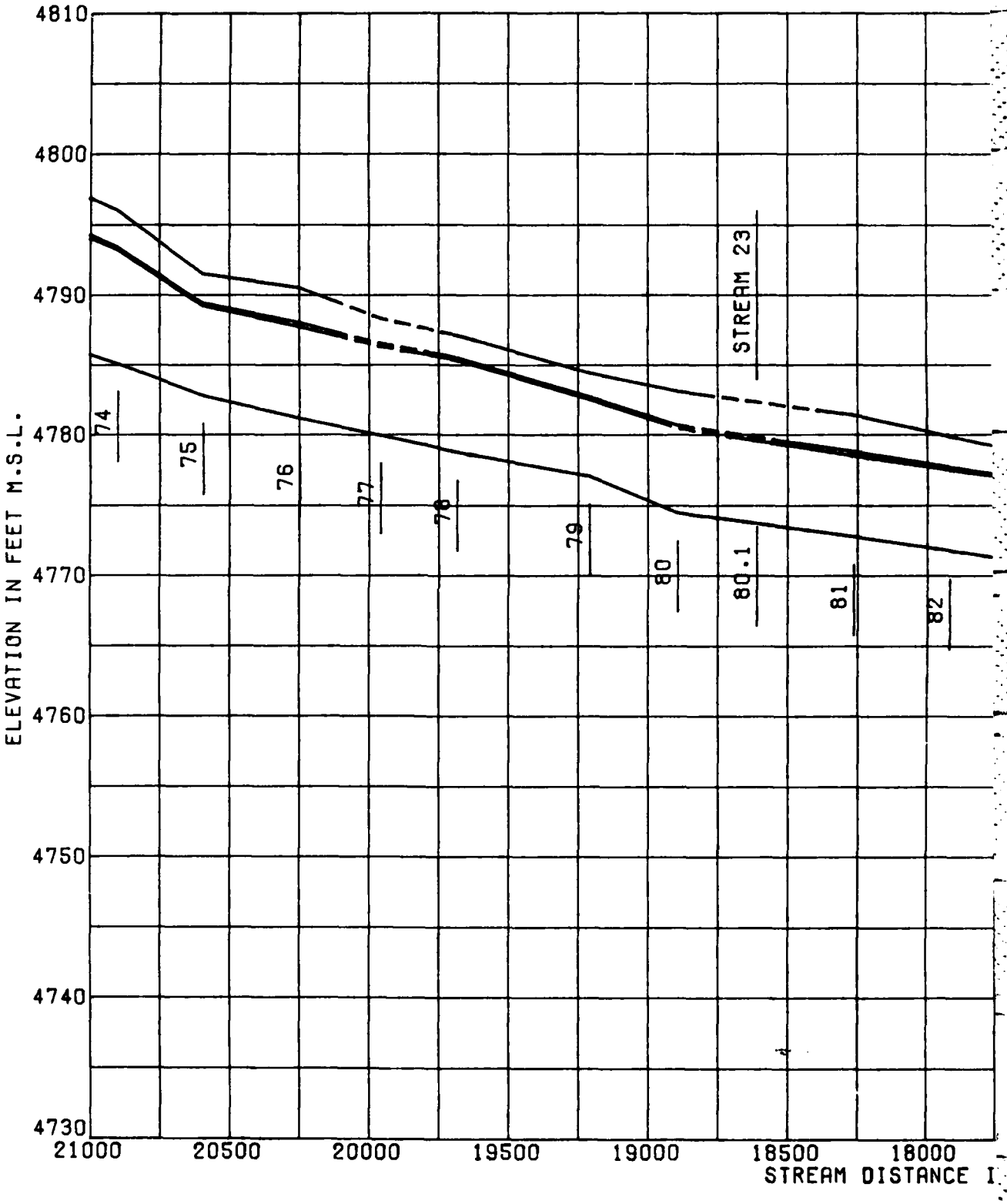

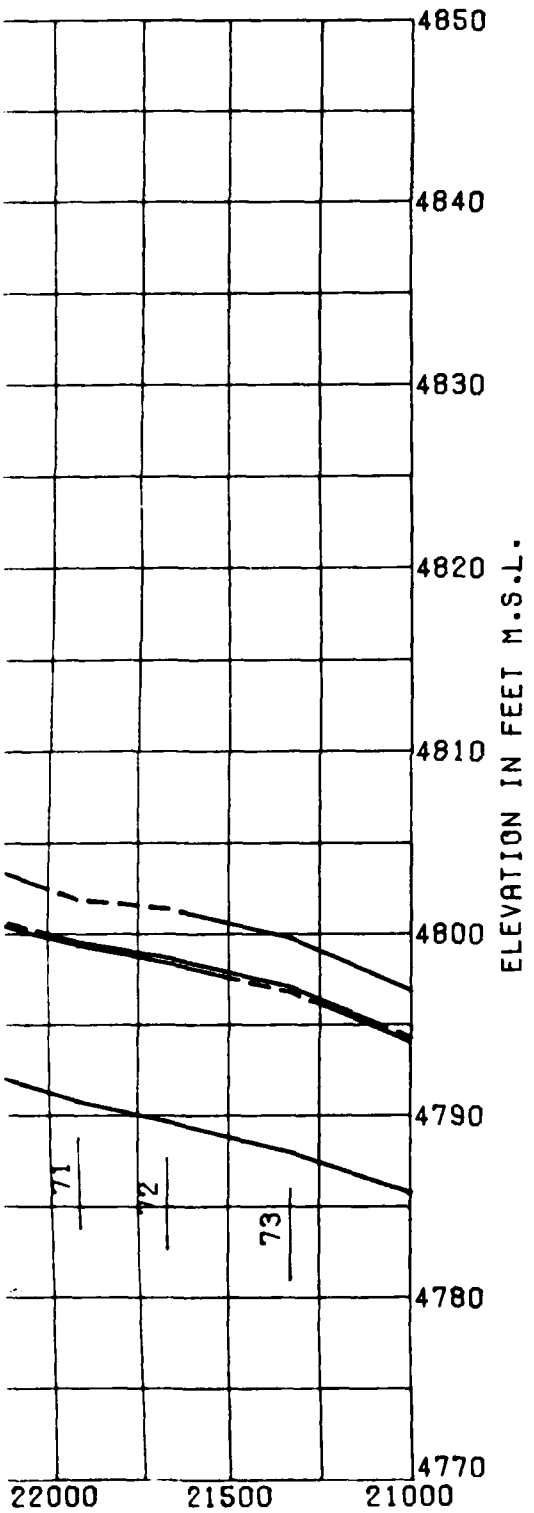

LEGEND:

- 100 YEAR FLOOD TOTAL URBANIZATION
- 100 YEAR FLOOD PROJECTED URBANIZATION
- 100 YEAR FLOOD EXISTING CONDITIONS
- Deck
- Bridge
- Low Steel
- Reference Point

NOTES:

1. For flood elevations at the *reference points, see Table 3.*
2. A low embankment extends part way across the channel at reference point 53.1.

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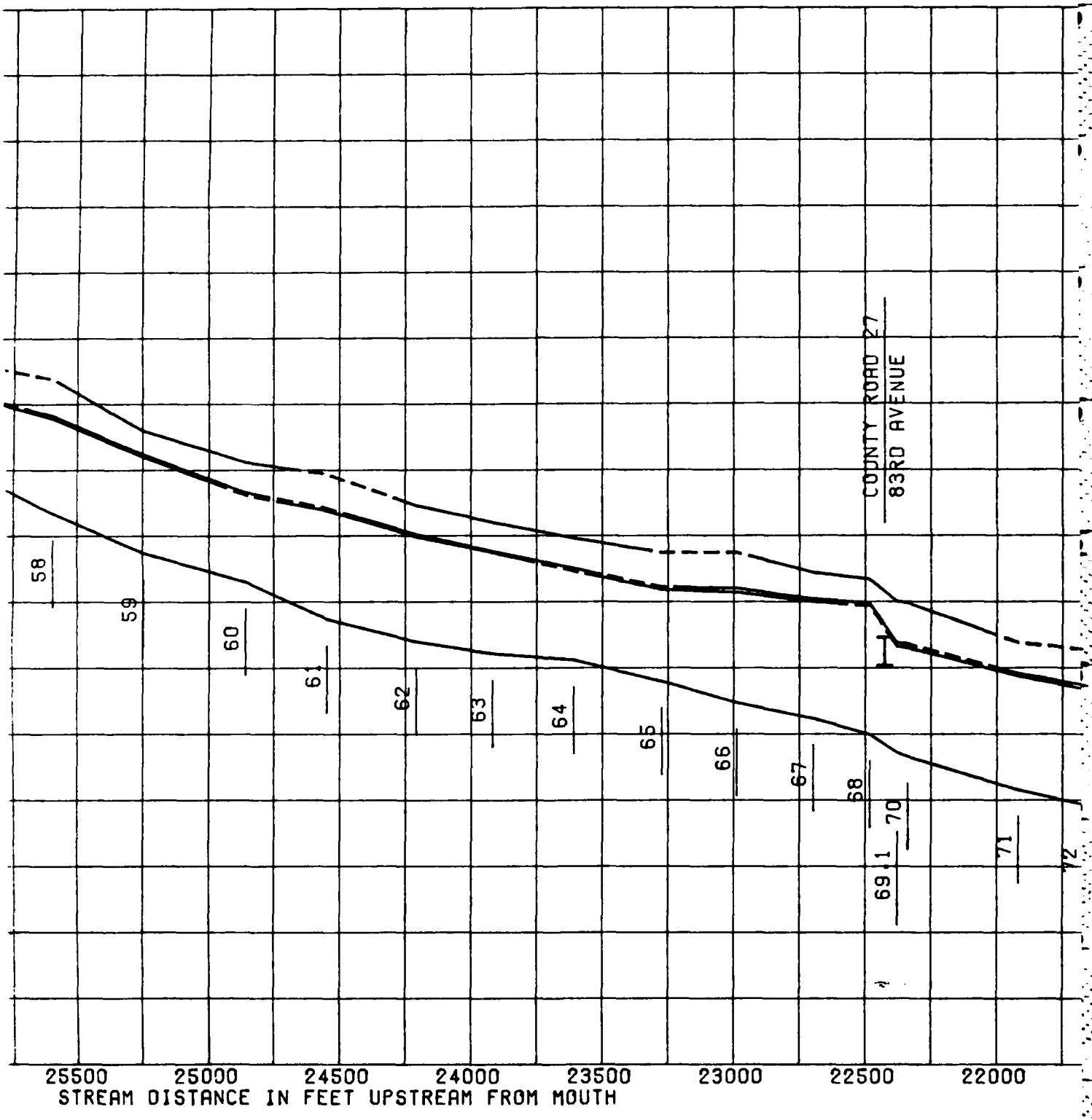

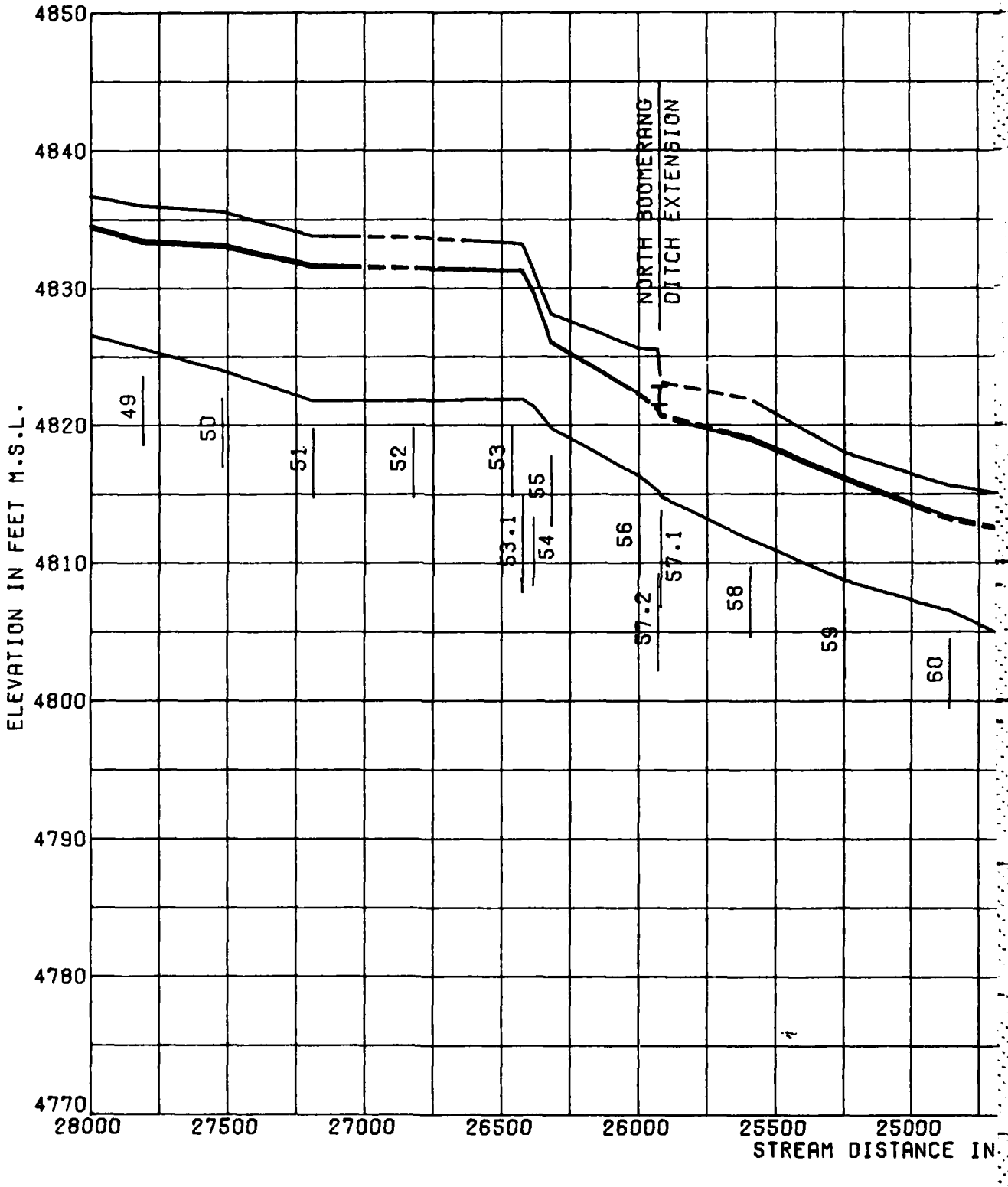

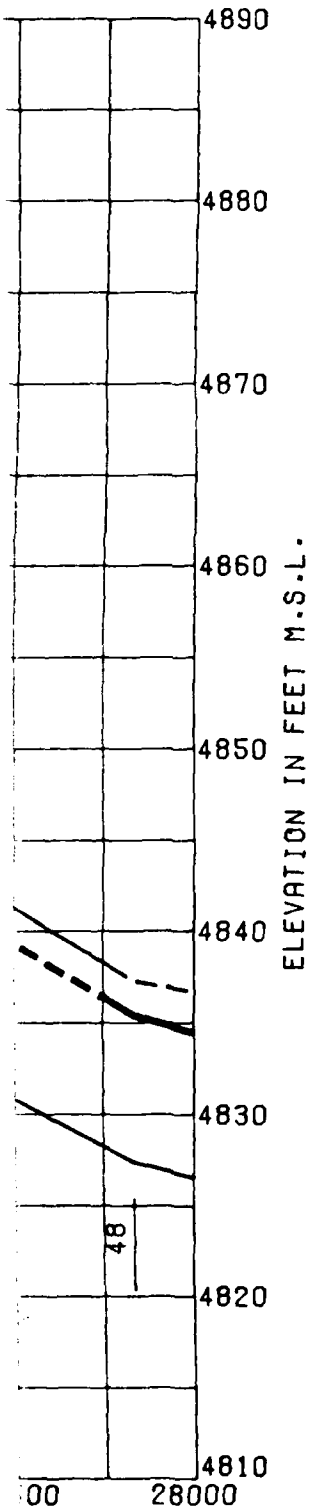

LEGEND:

- 100 YEAR FLOOD TOTAL URBANIZATION
- 100 YEAR FLOOD PROJECTED URBANIZATION
- 100 YEAR FLOOD EXISTING CONDITIONS
- Deck
- Bridge
- Low Steel
- Reference Point

NOTES:

1. For flood elevations at the reference points, see Table 3.

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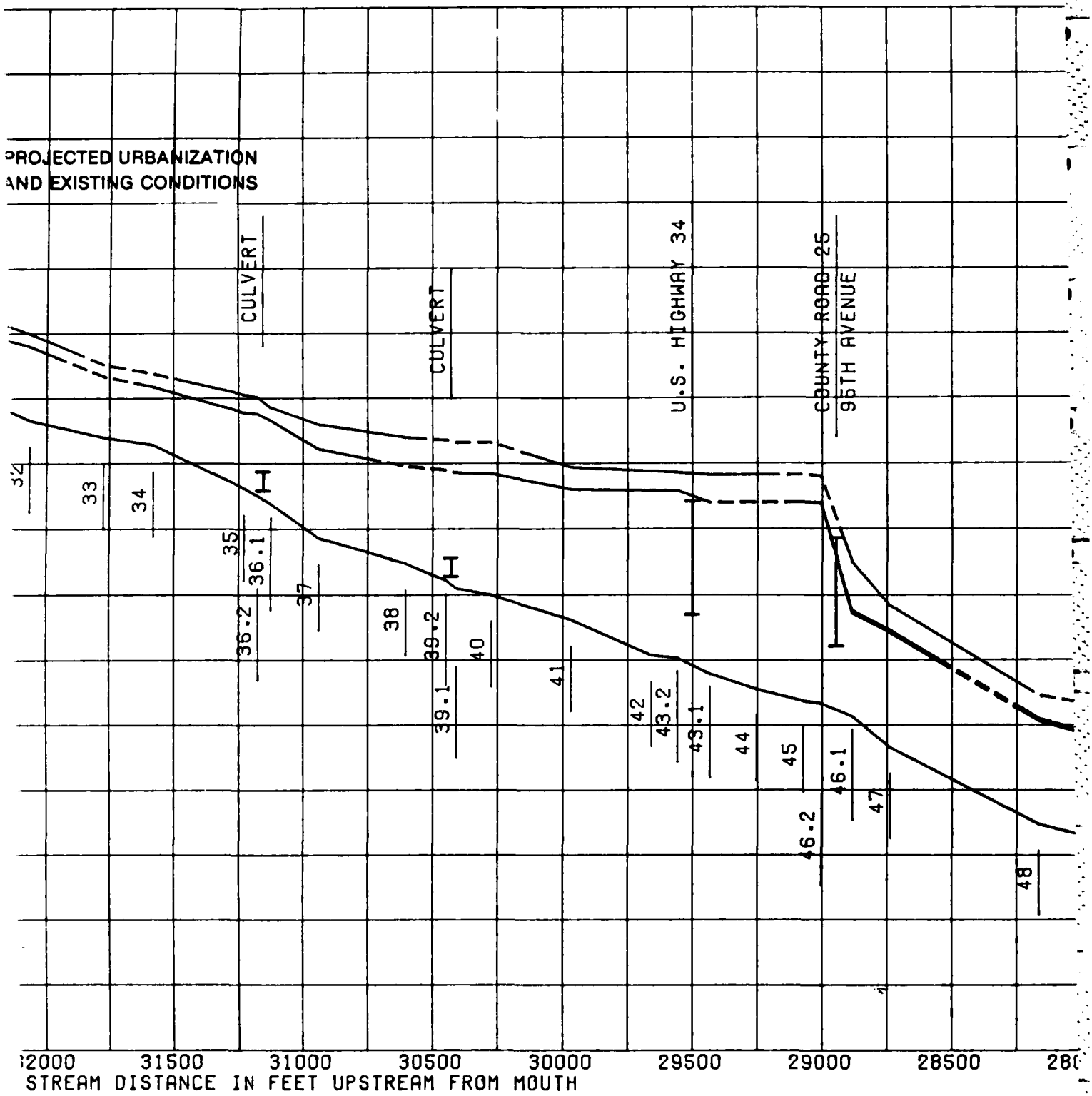

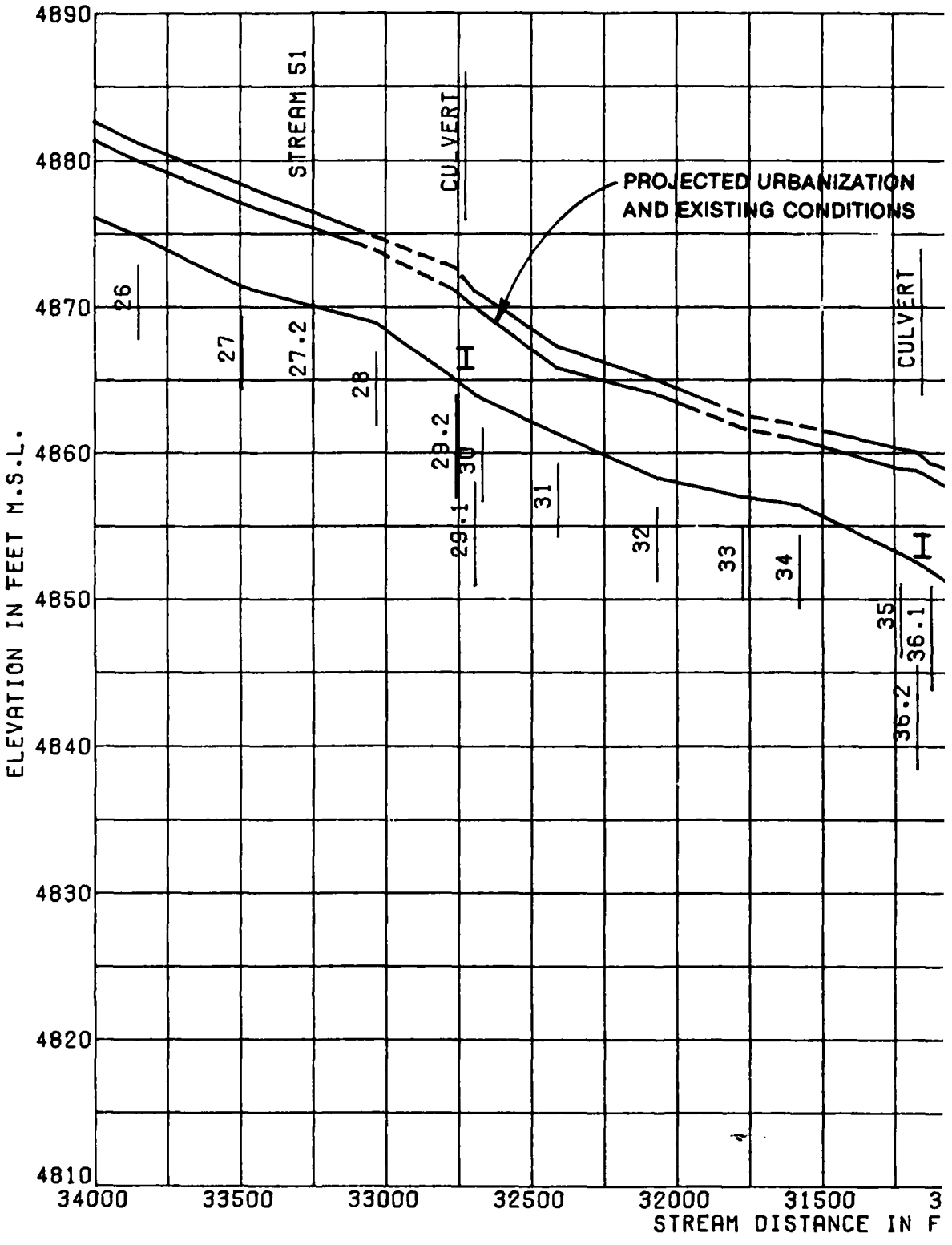

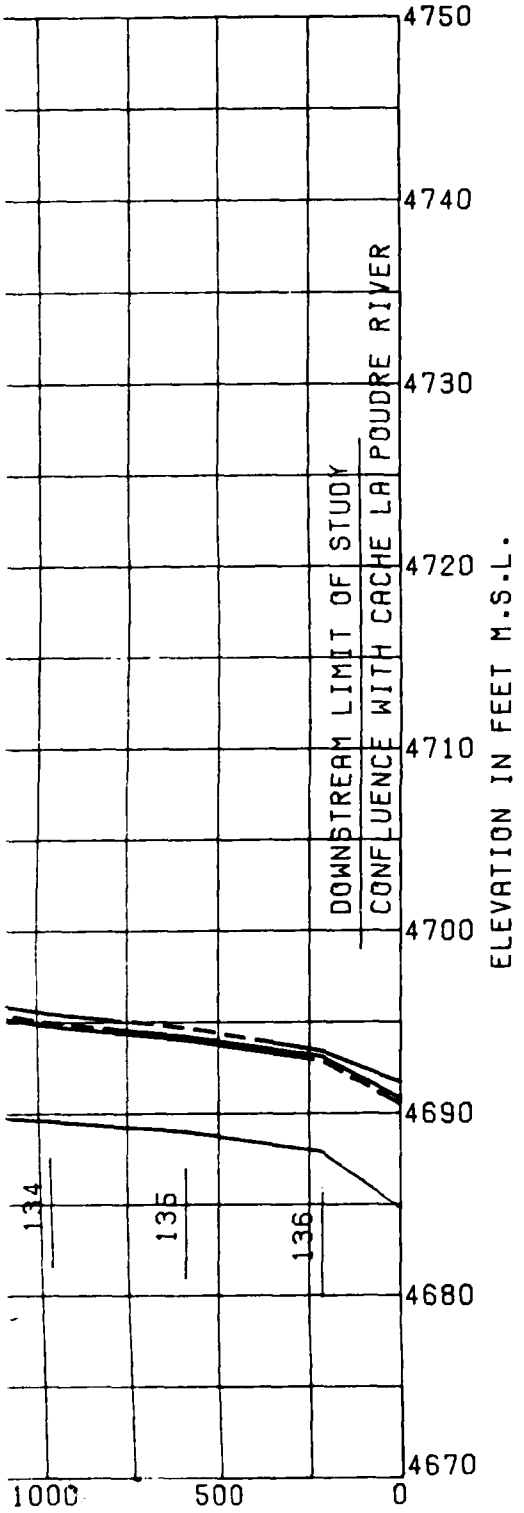

LEGEND:

- 100 YEAR FLOOD TOTAL URBANIZATION
- 100 YEAR FLOOD PROJECTED URBANIZATION
- 100 YEAR FLOOD EXISTING CONDITIONS
- Deck
- Bridge
- Low Steel
- 2 — Reference Point

NOTES:

1. For flood elevations at the reference points, see Table 3.

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